

BIRD ISLANDS OF PERU

ROBERT CUSHMAN MURPHY





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BIRD ISLANDS OF PERU



GUANO BIRDS ON LOBOS DE TIERRA.

Steplike nests of guanayes cover the lower hillside, with half-grown pelican chicks in the foreground, and adult pelicans along the crest.

Bird Islands of Peru

The Record of a Sojourn on the West Coast

By

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by the Author*

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To
G. E. B. M.

INTRODUCTION

VOYAGERS down the Pacific coast of South America sail for days through one of the great phenomena of nature and are rarely wiser for the experience. They are impressed by the barren character of the shores and mountain slopes, they marvel at the indescribable abundance of sea-birds without realizing that the existence of both deserts and birds is due to the same cause that induces them to don an overcoat though near the equator.

If Antarctica had extended an arm northward to the tropics overland instead of through the ocean the resulting effects on climate, flora and fauna would have been no more startling than those created by the Humboldt Current on its upward sweep along the shores of western South America. The occurrence of penguins on the coast of Peru is indeed no more surprising than would be the discovery of albatrosses on the Amazon. In a word, the Humboldt Current is responsible for conditions which make the Pacific coast of South America a region of exceptional interest to the

student of the distribution and interrelations of life.

What is the origin of this great, cold ocean river? Why is the coast it washes so barren? Why are birds so abundant there? Each of these questions gives rise to a score of others, and their answers lead us into the realms of oceanography, meteorology and ecology.

It was no easy task, therefore, that Dr. Murphy set himself when he sailed southward on the scientific conquest of the coast of Peru, and the success of his campaign is a tribute to the thoroughness of his training, the breadth of his interests, the keenness of his observations, and the soundness of his deductions.

The establishment of the unbroken chain of interrelations of organism with organism, from the lowest to the highest forms of life, inhabiting the Humboldt Current, and of their surprisingly delicate adjustment to their environment is a notable piece of field investigation. Furthermore, in describing the country and its life, as well as in recounting his studies and the conclusions drawn from them, Dr. Murphy has shown a skill in narration and exposition which should win the approval of both layman and scientist.

FRANK M. CHAPMAN

New York, Oct. 14, 1924.

PREFACE

THE specific objects of the expedition upon which this book is based were to investigate the oceanic conditions which are responsible for the abundance of life in Peruvian waters, as well as the interrelationships and distribution of this life; to make collections in the ocean and upon the islands for use in zoological studies and in the preparation of museum exhibits; and to obtain motion pictures of the bird life of the coast and of the re-organized Peruvian guano industry.

The expedition was in the field from September, 1919, until February, 1920. It was under the auspices of the Brooklyn Museum, with which the author was at that time associated as curator of the department of natural science, and was financed through a bequest of the late Colonel Robert B. Woodward, of Brooklyn, a former trustee of the Museum. The American Geographical Society and the American Museum of Natural History

co-operated with the Brooklyn Museum to the extent of supplying instruments of precision and other equipment for special phases of the work.

So many persons contributed to the success of the project that it would be impracticable to list their names in this preface. I wish, however, to acknowledge gratefully the constant hospitality and assistance of Señor Francisco Ballen, director of the national organization which administers the guano islands and the lighthouses of Peru, and of his associate, Señor José Antonio de Lavalley y García. Without the opportunities and counsel which these gentlemen gave me, the better part of my researches would have been impossible. Likewise, the firm of W. R. Grace and Company, which operates the only steamers to the West Coast under the American flag, extended many facilities in the way of transportation, introductions, the safe-keeping of supplies and collections, and the services of assistants at Callao and at two of the guano islands. To Mr. J. Louis Schaefer, vice-president, Mr. R. H. Eggleston, Jr., temporarily in charge of the Lima office, and Mr. Louis Loiseau, agent at Callao, I am indebted for favors too numerous to recount. Acknowledgments to others will be found in the text of the book.

Parts of this book were contained in a series of articles entitled "The Seacoast and Islands of Peru," published in the *Brooklyn Museum Quarterly* during the years 1920 to 1922. Other por-

tions, in only slightly different form, have also previously appeared in print. Thus the last quarter of Chapter I was published in the *Bulletin of the New York Zoological Society* for September, 1920; much of the first part of the same chapter in the *New York Evening Post* of June 17, 1922. Most of Chapter IV was issued in the *National Geographic Magazine* for September, 1924; Chapter VIII, in greater detail, in the *Geographical Review* for January, 1923; parts of Chapter XI in the *Bulletin of the American Museum of Natural History*, volume XLVI, 1922, and the *Scientific Monthly* for June, 1923. The portion of Chapter XII which deals with invertebrate animals was published in Spanish in the *Memoria de la Compañía Administradora del Guano*, Lima, volume XII, 1921. To the editors of several of these journals I am indebted for the privilege of republishing text and illustrations. The photographs are my own except for the three or four credited to others.

During the preparation of the manuscript I have had the ready help of several of my colleagues in the American Museum, as well as of Mrs. Murphy. From the time the expedition was first planned, Dr. Frank M. Chapman has given me full benefit of his broad knowledge of South American ornithology and geography. He has, moreover, read the entire text of the book, making many suggestions which have been incorporated; and, finally, he

has sponsored it to the extent of supplying the introduction. Mrs. Murphy has also read all of the proof, and is responsible for the detection and elimination of numerous errors and infelicities.

ROBERT CUSHMAN MURPHY

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CHAPTER I

THE ANCIENT CAPITAL AND ITS ENVIRONS

It was a quiet September evening—earliest springtime—when the ‘Mantaro’ anchored in the sleek-surfaced bay of Callao. If the afternoon wind had not entirely died, no breath of it reached us under the lee of San Lorenzo. The sun, which only a brief while before had dropped from the low-hanging curtain of cloud offshore, withdrew its rays into a dull globe upon which one might gaze unblinkingly, and rolled beyond the line of sky and ocean. Tall, limp sails of fishing boats glided past us to the rhythmical rattle of oars, and among them interminable files of cormorants beat their twisting ways as though the direction of flight were a matter of indifference. Through a thicket of square yards in shore the windows of the port began to gleam, but all land sounds were swallowed by distance. The impatience of a journey’s nearing end quelled

the usual merriment on board the steamer, and most of the passengers retired soon after dark to escape a stagnation broken only by the minor complaints and cacklings of sleepless gulls.

The bustle of the waterfront next morning was but a prelude to quickly sensed realization of more significant and ominous activities at the Peruvian capital. Lima, it seemed, was in the throes of political and social unrest. Even before daybreak, while we were still at anchor, obscure rumors had reached the 'Mantaro' of contemporary plots, of treason, imprisonments and exile, of assaults upon newspaper editors and the sacking of private homes.

After I had established lodgings in the Paseo Colón, I learned that a number of eminent Peruvian gentlemen to whom I bore letters of introduction had hastily left the country, whether by compulsion or in anticipation of it. Don Augusto B. Leguía, president-elect of the Republic and apparent choice of a great majority of the people, especially of the tradesmen, the students, the army, and the Indian citizens, had recently taken over the power by a *coup d'état*; and alleged conspiracies against the new régime had caused popular feeling to run high. Enthusiastic demonstrations before the Palace were common occurrences, and crowds which gathered for such a purpose were not always content to disperse without emphasizing their loyalty and admiration by attacking the prop-

erty of persons or organizations presumed to be inimical to the government. On the night before I landed, the office of *La Prensa*, in the principal business street of the city, was set on fire, and one of the first things that impressed me in Lima was the sight of small bands of Indian cavalrymen clattering through the thoroughfares to maintain order.

More disconcerting than political disturbances, however, were the industrial strikes which for nearly a month made it impossible for me to transport equipment, or even to have access to a ware-room lent to me through the generosity of the American firm, W. R. Grace and Company. The strikes began among the harbor and waterfront workers of Callao, most of whom maintained that they had had no increase of wages since before the World War, and spread until practically all commerce stopped. From day to day new proclamations were plastered on the multitudinous adobe walls of Callao, until printed exhortations to support the strike of the employees completely obscured the "*Viva Leguía!*" which had been the slogan of posters everywhere visible during preceding weeks. The strikes culminated on October 4, with the suspension of electrical power in Lima, and the consequent stopping of car-lines, the illuminating current, and electric water-pumps. But, after two lightless nights, some of the demands of the strikers were conceded; matters took a turn for the

better, and most classes of workmen returned to their tasks just as the printers began an independent strike that for some time prevented the publication of newspapers.

During this entire troubled period of September and early October, the streets of Callao were filled with groups of men ready to overturn carts and smash moving merchandise; the custom house practically ceased to do business; steamers from the north carried their Peruvian cargo southward to Mollendo or Valparaiso, with the hope of unloading on the return voyage; lighters, filled to the gunwales, lay at anchor deserted; shops were closed and bolted, or, if occupied by a lone proprietor, he was at least too intimidated to make sales. I found it impossible, for instance, to persuade the manager of a Callao nautical shop to sell me a certain chart before the termination of the strike, even though he was quite willing to have me use it upon his premises. Throughout most of the time of disorganization, drivers of public motor vehicles alone seemed to be privileged and quite unaffected; but when the Lima street cars stopped, these fellows, usually refreshingly moderate in their charges, seized the opportunity to profiteer merrily until the restoration of normal traffic.

While all of the circumstances noted combined to delay the beginning of marine investigations, they at any rate afforded me an opportunity to become acquainted with Lima and its environment

of mountain, seacoast, and fertile alluvial fan, and to meet many *Limeños*, including government officials and foreign residents as well as private citizens, whose cordial assistance went far to assure the success of my subsequent field work.

To enter into a description of the ancient capital of Spanish power in America would be trite, besides which, I must confess, I gathered little knowledge of the famed attractions of the city. In general, I found the plazas, historic structures, and business streets less alluring than the poorer quarter along the upstream banks of the Rimac, where there are narrow, winding, high-walled alleys, paved with the tiniest of round cobbles and lined with picturesque gateways and carved balconies, and where new and unexpected sensations of sight, sound, and smell greet one at every turn. To meander through such byways; to stumble upon queer little churches with tall crosses in their courtyards; to rub shoulders with peddlers who sell muscovy ducks from their backs, dangle carefully arranged baskets of strawberries from long bamboos, or balance huge wooden trays of *pastelitos* upon their heads; to breathe the scent of fostered roses and lilies in the patios of the humblest homes; to hear the rushing water of the Rimac behind tinted mud walls; and to catch a glimpse, through the open corridor of some well-peopled dwelling, of the bold cone of Cerro San Cristobal—all this seemed far less commonplace than to be tracing the historic footsteps

of Pizarro, which lead, after all, only to his big-boned skeleton in a glass repository under the cathedral.

The part of Lima more closely in touch with the modern world is, however, not lacking in the spirit and color to be expected of a venerable Latin-American city. Even strikes could not prevent the universal celebration of the Feast of Our Lady of Mercy, patron of the army of Peru, which took place on September twenty-fourth. At dawn of this day I was aroused by the wildest and most stirring trumpet flares that I had ever heard, and, hurrying to my balcony, I saw eight mounted buglers riding up the Paseo Colón. The air and pavements were wet with the peculiar *garúa*, or whirling mist of Lima, but the buglers sat straight upon their glistening horses, and their martial serenade defied the weather. The course of the day brought into strong contrast the social and spiritual pomp and the meteorological cheerlessness of Lima. All day long the miserable garua fell from dark skies, or, rather, filled the air, for the visible spray of vapor appeared to be rising as well as coming from above. Streets, walls, and clothing were soon soaked. I saw only one umbrella, doubtless in the hands of a foreigner, for it could have afforded little protection against the searching mist. I could not help feeling that the weather accorded with the mood of the mourning president, whose wife had died in London but two days be-

fore, rather than with that of the multitudes of celebrants in Calle Union and the Plaza de Armas.

The police of Lima, modest and inconspicuous little chaps, who had previously drawn my attention chiefly because of the bird-like whistles with which they sing "All's well" from block to block at every hour of day and night, had added white pompons, gloves, and gaiters to their uniforms in honor of the feast. The army came forth in dress garb. From morning till dark troops of all branches of the service paraded, or stood along the borders of the thoroughfares hour after hour in the steady drizzle. Neither the Indian troopers nor the mounted white officers showed by any sign that they were conscious of the drenching water-dust. Their arms and accoutrements all looked fit and bright. The infantry had bayonets fixed. At intervals, the machine-gun battalions had spread their outfits as if for action in the streets, and the lower part of Calle Union bristled with mountain batteries which had been unloaded from mule-back and assembled.

A more uniform body of men than the native Indians who make up the rank and file of the Peruvian army would be hard to imagine. They are all short-necked and stocky, with large calves that fairly bulge out through the folds of their puttees, and of an average height of about five feet six inches. After watching them on parade, and dur-

ing guard duty at the Palace and elsewhere, I must say that their seriousness and invariable dignity make an excellent impression. It is recorded, moreover, that Indians of this type gave the best of service to Peru and Bolivia during the unsuccessful defense against Chile.

In the afternoon, while the dismal garua still swirled, I stood opposite the Church of Our Lady of Mercy when the image of the army's patron was carried back from the street to the altar. The church was aflame with tapers, and packed with people. On either side of the entrance were piles of beggars, some of them with half-clad children, squatting and sprawling upon the cold, wet stone. The streets were so jammed that the military escort of the image of the Virgin could hardly force a passage. The image, on a white throne, decorated with vases of artificial flowers, was borne upon the shoulders of cassocked boys. The figure was garbed in white silk, covered with gold stars, and a heavy crown surmounted the doll-like head, from which a wealth of incongruous blond curls hung down below the waist. A smell of incense spread through the heavy air. Men bared their heads. Whatever inherent solemnity the scene might have lacked, from an alien point of view, was imparted by the absolute gravity and reverence of the onlookers.

To see Lima as a comprehensive whole, it is necessary to climb one of the mountainous spurs

which push toward the fringes of the city. My first excursion led me to the isolated ridge of San Bartolomeo, which stands at the southeast corner, in the middle of the entrance to the Rimac valley. Early one Sunday morning I walked inland along willow-lined Avenida Grau, the shadiest of Lima streets, half filled on this occasion with the wooden stalls of Sunday marketers who were selling every conceivable product. Here was a table piled high with whole carcasses of hogs; there one over which the sign "*carbon*" announced the sale of small sacks of coal at prices which made even those of New York seem moderate. Salt, sugar, dried and fresh vegetables, cooked food, salads gay with coral-like peppers, live chickens and turkeys, saddles and other leather articles, clothing, and lottery tickets were all displayed under the willows, and groups of Peruvians were bargaining everywhere. Some of the vegetables, especially cabbages, cauliflowers, and potatoes, were so large and fine that in the United States I had seen their like only in the colored lithographs of seedsmen's catalogues. Running in and out amongst the stalls and the legs of pedestrians were the innumerable and nondescript dogs of Lima, curs of all colors and structures, straight-haired, woolly, or hairless, from the size of a guinea pig to that of a great Dane, blending in their make-up the blood of aboriginal Inca breeds with the blood of Spanish sheep-dogs and mastiffs, and now all miserable, filth-eating, good-for-nothing mon-

grels who quarrel with the buzzards for their sustenance.

Owing to the maze of high mud walls and the dirty blind alleys beyond the end of Avenida Grau, I had difficulty in finding a way to the base of the hill, but the subsequent climb of eight or nine hundred feet well repaid the effort. Lima lay before me, like a map, on an extensive coastal terrace which sloped gently toward the sea, and which merged on the inland sides with five valleys separated by ridges such as the one upon which I was standing. Across the river on my right was the mount of San Cristobal, with a wireless station on its summit, and more lofty mountains of the Amancaes as a background. Straight ahead lay the main part of the city, with its many church spires, and, beyond, the distant masts and cross-trees in the harbor of Callao, and the bold crest of San Lorenzo Island. Southward down the coast was the headland known as the Morro Solar, high and clear-cut like San Lorenzo. All the rest was flat, cultivated plain—hundreds of fields marked off by adobe walls, and green with new vegetation, or brown with the last season's cotton plants, or bare soil newly plowed and furrowed for the irrigation water. In some of the green, walled pastures were herds of sleek cattle. Less fortunate cows and steers were foraging on the steep, nearly barren slopes of the mountain below me. Here and there, on dusty land in the outskirts of Lima, bands of

boys were kicking footballs about, showing how the sport of the *Inglés* had taken hold of the youth of Peru. Beyond all, in the west, was the sea, livened by spots of sunlight, although the sky over all the land was gray. South of San Lorenzo I could see a white thread of breakers on a reef offshore.

The fog-line for some period of each twenty-four hours was clearly indicated on all of the mountain ridges inland from my hill, for this undulating boundary marked the division between the faint new green hue of the thin vegetation above, and the parched reddish or sandy tone of the crumbling rock below. Even where I stood was a profusion of small trailing flowers, which yellow bees were visiting, and a good growth of fuzzy gray lichens on the rocks. Small, quick-moving butterflies were also about. Black vultures were flying along the hillside, and, being as yet so unsophisticated as to give a thought to human bones in Peru, I wondered whether they had eaten the flesh of a man whose pelvis projected from the sandy soil at my feet. Two sparrow hawks dived past me on their way towards the fields from which a loud chorus of bird songs was rising into the still air. On my way down I encountered many of the talented songsters at close range, and I remember particularly a wren that caroled explosively while it hopped in and out through the ribs of a dead horse.

A bird's-eye view of Lima, no less satisfactory than that which I have attempted to describe, may

also be enjoyed from the top of San Cristobal, whence one can look down directly upon the diffuse streamlets of the Rimac, and into that focus of Hispanic enthusiasm, the bull-ring. But more entrancing than any other is the panorama spread before the traveler who climbs the Morro Solar, where the Pacific seems to break upon the very flanks of the Andes, and where the people of modern Peru have co-operated with nature to make the compact, granite promontory, the *Herradura* strand, the cliff walk, the sheltered, sparkling bay, and the clean, white town of Chorillos, as charming as a bit of the Riviera.

From any point near the edge of its plateau-like top, the Morro Solar offers an outlook which is genuinely magnificent. Under the northern steep is a broad beach of fine sand at which, during summer afternoons, picnickers and bathers arrive by every car that winds down through the tunnels and the dunes. Beyond, is the tilled alluvial plain that extends to the purple, cloudflecked mountains, with Chorillos, Barranco, Miraflores, and Magdalena looking like toy villages built by children. Against the ridges in the north lies the metropolis, conspicuous, as always, from its church spires. Off-shore you see San Lorenzo end-on, and many outlying rocks, all veiled in fog on their windward sides. To the southward stretches an interminable white beach, backed by the green, swampy meadows of Hacienda Villa and by the desert upland of

Lurín, while at the right of these and far away, in an expanse which, under a clear sky, is as blue as the Mediterranean, the bright, two-summited islet of Pachacamac stands like a marble cathedral.

One September evening I waited upon the Morro Solar for the sunset, and for a time it was hard to choose whether to look toward the ocean and the orange sky above Fronton and San Lorenzo, or over the darkening valley with the pink-topped cordillera behind. When the sun went under as a fiery disk, the foam of the long rollers that broke upon the rocky shore turned from white to heliotrope, and most of the colors of both sea and land assumed indescribable richness and depth. For a brief while more, the birds could be seen flying over the bay, but the short-lived tropical twilight very quickly followed. As I returned to Chorillos around the eastern shoulder of the headland, the nighthawks were hunting, all moving southward against the wind, silently and close to the ground. Suddenly from the heights of the Morro Solar, I heard a burst of remarkable, metallic bird calls, which seemed like random staccato notes in the middle octaves of a piano. It sounded like the sustained singing of a single bird, and yet I could imagine no songbird capable of producing such volume and tone. Again and again the calls rang out mysteriously in the dusk. When I reached the base of the hill, the secret was divulged, for a flock of twelve ibises, singing a loud, harp-

like chorus, flew out as crooked-billed silhouettes against the evening sky. The individuals were, of course, only calling, but the combined voices made a real and enthralling song. The wedge of ibises appeared to be circling the upper part of the mount, for their music, which seemed instrumental rather than vocal, would grow fainter and fainter behind me, and then, after an elapse of ten minutes or longer, indistinct notes would herald the coming of the birds from the opposite direction.

* * * * *

The period of idleness caused by the strikes gave me an opportunity, to which I have previously referred, of establishing relations with men and institutions which ultimately more than compensated for the enforced delay in beginning field work. Indeed, the cordial co-operation of representatives of W. R. Grace and Company in Lima and Callao, of the American Chargé d'Affaires, of Doctor Fernando Fuchs, then Secretary of the Treasury of Peru, of several officers of the University and the Geographical Society of Lima, and particularly of Señor Francisco Ballen, the courteous and generous director of the national department administering the guano islands, contributed to the success of my work in a measure which can hardly be overestimated. I may say further, that from the Peruvian consul-general in New York to the customs officials of a dozen different ports,

and from the president of the Republic to the Indians of Lobos de Tierra, I found no citizen of Peru who was not willing and eager to help.

Shortly after my arrival, I had the pleasure of meeting President Leguía in his office at the Palace. I found the chief executive thoroughly informed regarding the present condition of the guano islands off the coast, and familiar with the studies of recent foreign investigators such as Dr. Henry O. Forbes, of Liverpool, and Dr. Robert E. Coker, of the United States Bureau of Fisheries. The president has himself visited one or more of the islands, and he keenly appreciates their importance to the future of Peruvian agriculture and finance. In the course of our conversation, he related many incidents concerning guano legislation and guano contracts in the past, and spoke with satisfaction of the increased output, and the still brighter prospects, due to modern conservational methods.

President Leguía speaks English with hardly an accent, and in appearance and manner he might well pass for a successful North American business man. His most generally recognized characteristic, never questioned even by political enemies, is personal courage. In the revolution of 1909, during his former term as president, he is credited with refusing to sign his resignation under the imminent threat of death, replying to his captors that only the will of the people could release

him from his responsibility. When rescued on this occasion, the president was in the midst of more than a hundred dead and wounded men who were heaped about the pedestal of Bolívar's statue.

No less typical of his fortitude has been his stand regarding aviation in Peru. He determined that his son, Juan, who had been an officer in the British Royal Air Force during the War, should be numbered among the pioneer flyers in his own country, where, owing to the difficulties of land transportation, planes are certain to assume great importance in commerce and national welfare. Some of the earliest coastwise flights, which thrilled the citizens of Pisco, Trujillo, and other towns of the agricultural valleys, were made by Lieutenant Leguía in company with the American aviator, Walter Pack. After a series of tragic disasters, which occurred early in 1920, resulting in the deaths of the chief of the French air mission, of Pack, of the Peruvian veteran Espinoza, and their associates, the president was still undaunted, and his son dropped flowers from the air upon the catafalques of his departed colleagues as a sign that the progress of national aviation was not to be interrupted.

One of my first visits in Lima brought me to the University of Saint Mark, founded in the year 1551, where I had the pleasure of inspecting the museum of science. In addition to several laboratories, the museum includes public exhibitions

which illustrate the mineralogy, botany, zoology, and archæology of Peru. These are installed in long, narrow corridors surrounding a patio of the ancient university building. Many of the specimens have been collected during recent expeditions sent into the field by the faculty of natural science. The zoological section contains exhibits of invertebrates, reptiles, birds, and mammals, while a habitat group of the guano-producing birds and their enemies constitutes probably the first example of this type of installation in Peru. The taxidermic work, it must be admitted, is inferior to that of modern museums in the United States, where the craft is now reaping the benefit of several decades of steady improvement in which fidelity to nature has been encouraged by competition and severe training.

Another municipal institution of much interest is the zoological park of Lima, which occupies a spacious and well-kept rectangle in the newer quarter, with entrances on the fashionable Paseo Colón. Admission into the park is ten centavos, the equivalent of five cents, and it appears to be well patronized not only by people who enter for the special purpose of seeing the animals, but also by visitors to the Exposicion restaurant, which is within the walls. After taking tea on the cool, shady balconies of the restaurant, it is a common custom of guests to stroll through the quiet pathways, beneath a dense canopy of green-black trees,

or along aisles of imposing royal palms, and to spend an hour or so in post-prandial contemplation of the comfortable enclosures in which the birds and quadrupeds are confined.

Although the Aztecs are said to have maintained at least two zoological gardens in Mexico before the advent of the Spaniards, I can find no evidence that the aborigines of Peru, who were no less enlightened than their northern contemporaries, had developed an institution of the sort. The *Encyclopædia Britannica*, in its references to South American zoological gardens, does not mention the existence of any modern park in Peru, and yet the appointments of the one in Lima give evidence that it has occupied its present site for upwards of a generation.

Previous to my first visit, in September, 1919, no Old World animals had been received for more than five years, or since the outbreak of the European war. Under the circumstances, the generally healthy condition of the large cats, the Asiatic and African antelopes, and other exotic creatures, testified both to the salubrity of the new environment and to the care exercised in feeding and sanitation. This was further substantiated by the presence of many young animals, born within the park, including two litters of vigorous and playful lion whelps.

The mammals observed during my visits comprised the following: Six lions, one of them a fine

old male whose roaring during the night could be heard all over the southern part of Lima; several tigers; jaguars, leopards, and other cats; striped and spotted hyenas; an Indian elephant; a number of dromedary and Bactrian camels, and a single camel calf; European fallow deer; various American deer; African antelopes of five or more species; zebus; Old World apes and many species of South American monkeys; agoutis, with subterranean brick retreats in lieu of burrows; squirrels, and a few other rodents; jackals, and South American wild dogs; peccaries in a pen with Galápagos tortoises; porcupines; North American and Eurasian bears, a Malay bear, and a pair of the very interesting spectacled bear of the Peruvian Andes, the only South American representative of the bear family.

As will be seen from the list, there was a relative paucity of small mammals. Nor were any reptiles noted, with the exception of the giant Galápagos tortoises referred to above. The latter were among the few creatures which seemed to find the climate unfavorable.

Although Lima is rather close to the Equator (12° S.), and is situated in the heart of a coastal desert, its type of weather is tempered by the cold ocean current of the west coast of South America, and during the southern winter it is subject to prolonged periods of cool, misty precipitation.

While the air is doubtless never cold enough to

warrant the construction of artificially heated compartments, the temperature is, nevertheless, often too low for the well-being of the tortoises out-of-doors. On days when the garua was falling, I often saw the poor brutes completely benumbed.

Regulations against feeding the animals, which seem to be so necessary in zoological gardens of the United States and Europe, are apparently waived in the Lima park, perhaps because the fruits and other tropical products which can be bought at the entrance to the grounds are suitable food for all of the animals that are not strictly carnivorous.

The aviaries of the Lima park interested me even more than the mammal quarters, partly because the variety of birds was greater, but especially because their environment seemed more natural and satisfying than that of the four-footed animals. Some of the feathered captives, such as hawks, parrots and songbirds, were kept in large roofed cages of the usual type, but practically all the waders and water-fowl enjoyed the freedom of good-sized fenced enclosures filled with waterways, trees, thickets, and rockeries, that furnished protection from the sun and opportunity for seclusion.

With no hindrance except a clipped wing, such birds could live normal lives, and hunt, display, mate, and rear their young much as they might in their native wilderness. On the largest pond in the park, swans and other swimmers lived, with no

fences whatsoever to restrain them, and on the surrounding shores they raised their broods.

Some of the birds which I noted in runways or cages distributed through the park were ostriches; emus; rheas; peacocks and other pheasants; tinamous of several kinds; hawks, caracaras, and owls; a large number of magnificent macaws; many parrots and parakeets; and a group of eight or ten Andean condors. It is not generally realized that the condors habitually fly down from the lofty mountains to the coast, and that they can be captured rather easily near Lima.

Within the water-bird enclosures, which I have already mentioned, were penguins; herons; ibises; Andean flamingos; mute and Australian black swans; ducks and geese of at least a dozen species; coots; pelicans, including the exquisite pink-white form of western Asia; Old World storks and marabous, and South American jabirus; and a beautiful selection of cranes—American, Asiatic, and African.

Altogether the assemblage of water-birds was the best I had ever seen. The individuals seemed entirely free from a sense of restriction or self-consciousness, and I well remember a pleasant morning spent in watching them, while coots and teals tipped-up in the sunlit pools, rails slunk through the clumps of tropical reeds, demoiselle cranes danced skittishly as if for each other's amusement, herons raised the gauzy plumes of their bridal veils, and

a solemn trio, composed of a wood ibis, jabiru, and Peruvian pelican, held a long-winded confabulation at the border of a pond.

In September, the European white storks were courting, showing that they were amenable to changing their seasonal customs after crossing the Equator. They were all taking part in a woodpecker-like chorus by rattling their bills, sometimes holding their heads and necks upside down along their backs during the performance. By the middle of October they had built bulky nests of fagots on bridges crossing the brook in their enclosure, and they subsequently raised broods of storklets, which, of course, remained long in the nest, and seemed very helpless and infantile when compared with the lively chicks of the demoiselle cranes.

Aside from the "zoo" birds, the Lima park is the home of a wild avifauna of much interest. Two or more species of doves fly into the enclosures to feed with the captive birds, and many tropical songsters, among which are most garrulous and irrepressible wrens, live in the hedges and in the thick foliage of the trees. Tiny house-swallows, called "Santa Rositas" in honor of Lima's patron saint, skim about all day within an inch or two of the paths, and vermilion flycatchers occasionally can be seen clicking off insects in the higher spaces. At evening, barn owls perch along the roof of the Exposition palace, and night hawks sally forth into the Paseo Colón. But the most conspicuous of the wild

birds are the black vultures or *gallinazos*, which at all hours wheel in a definite circle of the sky above the park, and which descend every morning to gobble up the offal in a slaughter-pen where the food of the flesh-eating mammals and birds is prepared.

All in all, the Lima park seems to be an institution of genuinely popular purpose. The management has erected seats and summer-houses throughout the grounds, and has planned in all ways for the comfort of visitors. Competent gardeners have made the most of the rich soil and favorable climate in working out the floral features, and in providing for irrigation. The park is kept scrupulously clean, and the Peruvian public neither litters it with rubbish nor plasters the bottoms of the benches with American chewing gum. On certain afternoons, military bands, made up almost entirely of the music-loving Peruvian Indians, give concerts which never fail to be well attended. Of other familiar appurtenances, even to the ingratiating "official artist" who photographs you in front of the elephant pen and prepares the pictures while you wait, there is no lack.

Considering the climate of Lima, which agrees particularly well with captive birds, there would seem to be an opportunity for the authorities of the zoological park to draw upon the marvelous resources of the interior of Peru, especially of the Amazonian *montaña*, and to develop at the capital a tropical aviary which would have no peer.

CHAPTER II

THE SEACOAST OF THE INCAS

FROM the days of the *Conquistadores* the name of Peru has conveyed the idea of riches, an idea based upon both the largess of nature and the creative power of indigenous peoples. First it was the alluring thought of precious metals, in association with a culture no less exotic than any which Europe had found in the Orient, which enkindled desire for mastery over the resources of the Incas. Thereafter, as is perhaps inevitable in regions of imposing natural wealth, exploitation in many forms continued so greatly to predominate over development that most of the truly memorable accomplishments of the past, such as the ancient agricultural and pastoral systems, were all but lost.

In modern opinion, as well as in that of the sixteenth century Spaniard, the outstanding features of the wealth and charm of Peru have been associated chiefly with the interior of the country. It is here that the conspicuous native wonders lie,

whether man-built, like the monuments of Cuzco and Machu Picchu, or the result of mighty earth movements such as produced Lake Titicaca, whose deepest bottom is higher above sea-level than Mount Hood; or the double peaks of Huascaran, which reach six thousand feet beyond the loftiest summit of the Alps. Here, too, in the cordilleras, are the well-advertised mineral deposits, the fame of which has gone far to obscure the fact that the annual value of the Republic's crops, grown mainly in valleys of the coastal desert, is greater than that of the combined output of gold, silver, lead, copper, mercury, vanadium, coal, and all other products of Peruvian mines. And beyond the Andes lies the pristine *montaña*, the hot, well-watered, forest land of Amazon drainage, where a boundless future in timber, in tropical husbandry, has thus far been only dreamed, and the richness of which is barely beginning to be tapped through Peru's "Atlantic port," Iquitos.

In comparison with the spell of the interior, which affects very nearly all minds, the appeal of the long, shining coast of Peru seems to have been felt by few. The voyager gazes at bare, dead, cloud-topped ranges, colorful, indeed, and faced at evening by matchless sunset skies; but the endless succession of parched mountain and parched desert, of blistering coastal terraces and dark, forbidding cliffs, may ultimately become monotonous. Calls in the unsheltered roadsteads of small ports

fail, perhaps, to bring the anticipated relief; for the inhabitants, their dwellings, and the intermingled green, still seem somehow to be swallowed up by the illimitable aridity around them. The voyager encounters, moreover, a littoral ocean which, although practically stormless, is rolled up by steadfast southerly winds into great swells and surf which at many points render embarking and disembarking a serious inconvenience. Of the extremely profuse wild life of this coastal ocean, he may chance to observe no more than sea-lions and vast flocks of birds; and if he seeks a traditional product of the waters which can compare in importance with the marvels of the interior, he finds only guano, the ammoniacal smell of which strikes his nostrils whenever the steamer draws into the lee of bird-inhabited islands.

To the geographer, however, to the student of the distribution of life, and to all who are interested in resources of the sea, the shores and littoral waters of Peru offer a fascinating field for exploration. Marine life of many kinds flourishes here in amazing abundance. The entire length of the coast is bathed by a cool ocean current, more uniform in character and more profound in its influence upon climate and living things than any other in the world. The current is not only indirectly responsible for the existence of the guano birds, and for all the other spectacular evidences of prolific life, but, moreover, in its relation with the configuration



Photograph by F. M. Chapman.

TALARA AT LOW TIDE, NORTHERN PERU.



Photograph by F. C. Walcott.

MOLLENDON, THE SEAPORT OF SOUTHERN PERU.

of the coast and islands on the one hand, and with the outlying heated water of the tropical Pacific on the other, it produces areas of distinct ocean temperatures which appear to be hardly less significant in their effect upon the ranges of animals than the famous climatic life-zones of the adjoining continent.

From the summit of the Morro Solar, the characteristics of Peruvian coastal climate may be felt and seen in a graphic way. The hill rises from a plantless desert, but its high plateau supports a rather varied mist-fed vegetation, composed of species which show pronounced drought-resisting adaptations, such as tuberous roots, succulent stalks, fleshy, frosted, or hairy leaves, etc., and which in September are in full flower. Conspicuous among them is a club-cactus whose scarlet blossoms are frequently visited by exquisite *pica-flores*, or hummingbirds. The arid base of the mount may be sweltering in tropical heat, while its plateau is swept by a cold wind from the Pacific. I have stood, indeed, on a fair spring day, beside the lichen-covered cross which tops the peak above Chorillos, and have found an overcoat altogether insufficient to protect me from the piercing breeze. A stranger experience, however, is to start from Lima at a time when the city is filled with steaming garua, and to find only open skies above the Morro Solar. A glance northward from the hill may show Lima still hidden in murk, while the margins

of the valley, and the surrounding ranges, all bask in sunshine.

Peru lies within the zone of the southeast trade winds, which carry the abundant moisture of Atlantic evaporation across the continent, and deposit it as rainfall upon the country to the eastward of the Andes. The cold highlands, however, condense the last of this wind-borne vapor, so that the trade wind passes over to the western slopes of the cordillera as a dry breeze. Moreover, the increasing barometric pressure, to which the air is subjected as it descends towards the Pacific, raises its temperature and its desiccating power. The coastal winds of Peru, which are the peripheral air currents of a well-marked anticyclonic area in the eastern South Pacific, are prevailingly southerly, blowing with great regularity, throughout the year, from points between southwest and south-southeast. As a rule, the diurnal *virazon*, or sea breeze, follows a course not far from parallel with the main trend of the shoreline, making a slight angle with it as it passes from the ocean to the land. It is at the latter transition that the presence of the Humboldt Current contributes to the aridity of the coastal belt, for the moist winds, proceeding from a long, diagonal course over the cool stream to a warmer land, have their temperature raised and their capacity for water vapor consequently increased. On the other hand, at places where the topography of the coast forces the onshore wind to

rise rapidly, the cooling due to expansion lowers the saturation point and causes condensation in the form of mist and cloud, which is responsible for the vegetation of the hilltops. During the southern winter, when the difference in temperature between sea and land is least, fogs are frequent along the coast, and a prevailing pall of cloud extends seaward from the coastal mountains. The latter part of this season is the *tiempo de lomas*, when ephemeral flowers bloom on the hilltops.

I have inferred above that the water of the Humboldt Current lowers the temperature of the air which moves across it. In other words, since its capacity for heat exceeds that of air, it absorbs heat from the latter. The pronounced cooling effect of the current upon the whole coast of Peru may be understood when the vast difference in the specific heats of water and atmosphere is appreciated, for the absorption of sufficient warmth from the air to raise the temperature of a given mass of water one degree will result in a mass of air of 3,000 times as great a cubic content being lowered one degree in temperature. It is by no means surprising, therefore, that the mean annual temperature of Lima is 4.6° F. below the theoretical value for its latitude (12° S.).

To account for the peculiar persistence of garua at Lima between June and September, when it often falls even while the nearest suburbs are dry, we must seek a clue in the local topography. The

capital has an altitude above sea-level of about 500 feet, and, as I have already stated, mountain spurs closely approach it; on the northern side they actually penetrate into the outskirts of the city. Probably the cooling of the saturated sea air, when it climbs these abrupt hills, together with condensation produced by counter breezes issuing from the Rimac valley, or from the gorge east of Mount San Jerónimo, are responsible for the dense, low-hanging cloudiness and the vaporous precipitation. Whatever the precise cause, the sun is obscured for weeks at a time during the winter season, and paste, instead of dust, covers the streets and sidewalks. An appropriate tradition tells us that when the Incas learned of the site chosen by the hated Pizarro for the capital of New Spain, they rejoiced, because among them it was notorious for abominable weather.

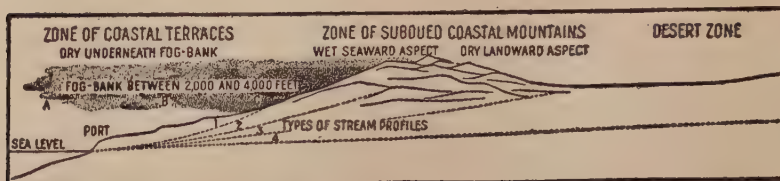
In closing these remarks, I cannot do better than to quote from the chapter on climatology in Dr. Isaiah Bowman's 'The Andes of Southern Peru' (1916), a work which, because of exact and expressive descriptions, illuminating interpretations, and the admirable manner in which the physical environment is shown to be correlated with the status of human society, is no less delightful than indispensable to all who wish to know Peru:

To the traveler on the west coast it is a source of constant surprise that the sky is so often overcast and the

ports hidden by fog, while on every hand there are clear evidences of extreme aridity. Likewise it is often inquired why the sunsets there should be often so superlatively beautiful during the winter months when the coast is fog bound. Why a desert when the air is so humid? Why striking sunsets when so many of the days are marked by dull skies? As we have seen, . . . the big desert tracts lie east of the Coast Range, and there, excepting slight summer cloudiness, cloudless skies are the rule. The desert just back of the coast is in many parts of Peru only a narrow fringe of dry marine terraces quite unlike the real desert in type of weather and in resources. The fog bank overhanging it forms over the Humboldt Current which lies offshore; it drifts landward with the onshore wind; it forms over the upwelling cold water between the current and the shore; it gathers on the seaward slopes of the coastal hills as the inflowing air ascends them in its journey eastward. Sometimes it lies on the surface of the land and water; more frequently it is some distance above them. On many parts of the coast its characteristic position is from 2,000 to 4,000 feet above sea level, descending at night nearly or quite to the surface, ascending by day and sometimes all but disappearing except as rain-clouds on the hills. Upon the local behavior of the fog bank depends in large measure the local climate. A general description of the coastal climate will have many exceptions. The physical principles involved are, however, the same everywhere. . . .

Three typical positions of the fog bank are shown in the figure, and a fourth—that in which the bank extends indefinitely westward—may be supplied by the imagination.

If the cloud bank be limited to C only the early morning hours at the port are cloudy. If it extend to B the



sun is obscured until midday. If it reach as far west as A only a few late afternoon hours are sunny. Once in a while there is a sudden splash of rain—a few drops which astonish the traveler who looks out upon a parched landscape. The smaller drops are evaporated before reaching the earth. In spite of the ever-present threat of rain the coast is extremely arid. Though the vegetation appears to be dried and burned up, the air is humid and for months the sky may be overcast most of the time. So nicely are the rain-making conditions balanced that if one of our ordinary low-pressure areas, or so-called cyclonic storms, from the temperate zone were set in motion along the foot of the mountains, the resulting deluge would immediately lay the coast in ruins. The cane-thatched, mud-walled huts and houses would crumble in the heavy rain like a child's sandpile before a rising sea; the alluvial valley land would be coated with infertile gravel; and mighty rivers of sand, now delicately poised on arid slopes, would inundate large tracts of fertile soil.

If the fog and cloud bank extend westward indefinitely, the entire day may be overcast or the sun appear for a

few moments only through occasional rifts. Generally, also, it will make an appearance just before sunset, its red disk completely filling the narrow space between the under surface of the clouds and the water. I have repeatedly seen the ship's passengers and even the crew leave the dinner table and collect in wondering groups about the port-holes and doorways the better to see the marvellous play of colors between sky and sea. It is impossible not to be profoundly moved by so majestic a scene. A long resplendent path of light upon the water is reflected in the clouds. Each cloud margin is tinged with red and, as the sun sinks, the long parallel bands of light are shortened westward, changing in color as they go, until at last the full glory of the sunset is concentrated in a blazing arc of reds, yellows, and purples, that to most people quite atones for the dull gray day and its humid air.

At times the clouds are broken up by the winds and scattered helter-skelter through the west. A few of them may stray into the path of the sun temporarily to hide it and to reflect its primary colors when the sun reappears. From the main cloud masses there reach out slender wind-blown streamers, each one delicately lighted as the sun's rays filter through its minute water particles. Many streamers are visible for only a short distance, but when the sun catches them their filmy invisible fingers become delicate bands of light, some of which rapidly grow out almost to the dome of the sky. Slowly they retreat and again disappear as the rays of the sun are gradually shut off by the upturning curve of the earth.

* * * * *

"When you see no more trees, it is Peru," said a native of the country to expectant passengers on board the steamship 'Mantaro' on September 5, 1919. On the morning of the third we had left the Pacific entrance of the Panama Canal, and by late afternoon of the fifth had arrived off the wooded Ecuadorian island of La Plata, a little to the northward of the Gulf of Guayaquil. All the while that we were within sight of La Plata large rays, with pointed fins, kept leaping from the warm ocean and flopping back with great splashes. Their white under surfaces gleamed as they turned complete somersaults in the air, and they were bursting forth so thickly from the water that many were above at once. Judging by several that shot up within a stone's throw of the steamer, they were about four feet in length. At the same time a 'bos'n' or tropic-bird, with a streaming tail, flew close to the 'Mantaro,' and familiar man-o'-war birds sailed out from the direction of the distant island. The peculiar significance of the rays and the two species of seabirds at this place did not become evident until we had gone a half day's journey beyond.

The night that followed was abruptly and strangely cool from the point of view of travelers who had within a few hours crossed the equator. At dawn of September 6th we could see at our left the yellow deserts of northernmost Piura. The belt of vegetation now lay behind us, and ahead stretched

an arid coast, which was to undergo no marked climatic change for nearly two thousand miles, or until succeeded by the rain forests of southern Chile. The dramatic suddenness of the break between the mangrove swamps and tree-bordered savannahs of Ecuador and the deserts of Peru might have been appreciated even more vividly if we had sailed into the Gulf of Guayaquil, as I did on the return voyage, and had seen the luxuriant green isle of Puna on one beam and the bone-dry table-land of outer Tumbes on the other.

As soon as the 'Mantaro' passed Cape Blanco and began to steam along a coast which bristled with petroleum wells toward Point Pariña, the western extremity of South America, signs multiplied that we had definitely left astern a zone of the humid tropics and had entered the province of the mighty Humboldt Current. Characteristic southerly winds replaced the doldrum airs of preceding days, and the doffing of white uniforms by the ship's officers was coincident with a fall in temperature which indicated the refrigerating effect of colder seas. From the dark, terminal rocks of Point Pariña came the barking and wailing of *lobos* or sea-lions, a southern species which inhabits the west coast uninterruptedly from Cape Horn northward to the edge of the warm water. It seemed to me on this day that Pariña, in latitude $4^{\circ} 45'$ south, marked a line which, unlike the equator, could hardly be called imaginary, for it

separated two great marine realms of striking differences in both physical features and faunal types. North of the point many white-headed Galápagos albatrosses were sitting in small groups upon the ocean; south of it we met the first white-breasted cormorants and variegated gannets, guano birds whose northward range ends sharply here. The tropical brown pelican, which we had seen occasionally all the way from the Isthmus to the Gulf of Guayaquil, was with us no more, but in its place was the much larger Peruvian pelican or *alcatraz*. No longer did flying fish scud away before the steamer; no longer did leaping rays catapult from the waters, nor were equatorial 'bos'ns' and man-o'-war birds present to cross the 'Mantaro's' course. The seabirds which now followed our vessel like satellites were kelp gulls, the very same that live also in the glacier-fringed Strait of Magellan and along all shores of the Antarctic Ocean.

In the afternoon of September 6th we entered the harbor of Paita, and came to anchor not far off the town and the gullied cliffs. The brink of the latter was marked here and there with gaunt crosses which stood out clearly against the sky. Rowboats and ponderous lighters soon followed the launch of the port physician alongside the steamer, and presently there was great confusion as boatmen carrying chests and bundles, bird-cages containing black troupials, baskets of fruit, shackled ducks and peacocks, and other queer luggage,



Motion picture film.

BULL SEA LION COMING ASHORE IN THE SURF OF SOUTH CHINCHA ISLAND.



Motion picture film.

A PENGUIN CHICK WHICH WAS THE PET OF THE GUANO STATION AT CENTRAL CHINCHA ISLAND.

crowded up the landing steps at the same time that disembarking passengers were descending with trunks and bags. Owing to a yellow fever quarantine, no vendors were permitted to come aboard, so the Indians in dug-out canoes, which are importations from Ecuador, could only hold up their samples of Panama hats and other wares, and attempt to bargain from a very disadvantageous position. They soon became discouraged, and left us for a Chilean steamer which came into port on the heels of the 'Mantaro.'

The graceful log canoes were not the only native boats near by, for several rafts made of the celebrated, featherweight *balsa* wood, which likewise comes from the north, brought off supplies of fresh fish for the 'Mantaro's' galley. Some of the *balsas* used in northern Peru are commodious, rigged craft, which can transport entire families. Even after I had become thoroughly familiar with them, and with the wood of which they are constructed, I never ceased to feel astonishment at seeing a single Indian casually pick up a tree trunk almost as big as a telegraph pole, and carry it away on his shoulder.

The color of the late afternoon light and early evening shadows on the mysterious dried-up bluffs of Paita was particularly effective. While the western sky over the headland at our right was still red, the moon shone with a clear, cold light. The lamps of the town began to peep out against the

weathered, bronze and purple embankments. The cool wind died away and left a calm. An impressionable Italian on board, a member of Lázaro's opera company which was journeying toward Lima, could no longer contain himself. He walked ecstatically back and forth along the deck, gazing at the vivid crest with its tall crosses, and waved an arm toward the scene while he half-sang the exclamation, "*Una panorama suprema!*" To me, too, it seemed that the moon had never been so gleaming white, but not till long afterwards did I learn what every Peruvian knows from childhood, that *la luna de Paita* is the fairest in all the world.

Between Paita and Callao, the seaport of Lima, we called at the roadsteads of four other Peruvian towns, the leisurely trip giving an opportunity for becoming further acquainted with the character of the coast and with some additional phases of its animal and human life. At the northern ports of Pimentel, Eten, and Pacasmayo, we took aboard a picturesque lot of third-class passengers, poncho-clad Indians whose large families and varied possessions soon filled up the afterdeck. Their smaller domestic animals, including fowls sewn up individually in bags so that only the heads protruded, traveled with them. At Salaverry this aggregation of open-air tourists was augmented by a troop of gypsies, the women managing a score or so of children, the bewhiskered men giving most of their attention to an uncounted number of dogs.

At Paita I had acquired perforce a cabin-mate—an educated, self-sufficient, fat but neatly clad little mountain Indian, who never smiled. He traveled first class as the accountant of an established British commercial house. Like most of the Andean people, he frankly had no use for the Pacific Ocean, and not only slept with his clothes on and his baggage packed, but also sprang to the door at any hour of day or night if the steamer's engines perceptibly changed their revolutions. We conversed mostly by signs, for whenever I blundered into faulty Spanish phrases he would lose all thought of their meaning in his eagerness to restate them correctly; and he always followed his ministrations with a sharp, schoolmastery command, in English, "Please repeat!" He made me understand that he had studied English, but he was too wary to give me the advantage in our exchanges. On the third morning of our companionship, however, he looked down solemnly from the upper berth, and announced,

"Save a t'ief from de gallows and he will cut your t'roat."

To this gallant and complimentary effort I felt obliged to respond in kind, so I answered with a proverb of Sancho Panza, learned perfectly from the cultured Spanish professor in the phonograph:

"En la tierra de los ciegos, el tuerto es rey" (In the land of the blind, the one-eyed man is king).

My cabin-mate said no more, and at San Lorenzo

Island he departed for quarantine without a word or a wave of the hand.

Many times every day the passengers on the 'Mantaro' were torn from spellbound reveries over the colorful mountains by the sight of vast, seething schools of surface fish, breaching whales, incredible flocks of birds, or bands of frolicking lobos. North of Pimentel, on the afternoon of September seventh, the steamer ran into an enormous shoal of porpoises, far larger than any I had ever seen throughout a hundred degrees of latitude in the Atlantic. Close alongside scores were leaping in magnificent display, and a short distance off, where the main body was evidently centered, they made an acre or more of the ocean fairly boil. Many of the pelagic birds that we met, such as Cape pigeons, mollymokes, and skuas, were my old friends of the South Atlantic, where, however, I had observed them only in much higher latitudes, toward the borders of the Antarctic Ocean. The Peruvian guano birds were encountered in greatest abundance in the neighborhood of islands upon which they breed, such as Macabí, Guañape, and the Pescadores. When I came out of my cabin on the morning of September 9th, Macabí lay ahead, shining like an opal in the early sunlight. Dark patches on its upper parts indicated the areas occupied by the colonies of white-breasted cormorants or *guanayes*. When we came abreast of the islet the air above it was filled with a cloud of birds, and

soon afterwards an army of guanayes began to file past the 'Mantaro' and across her bow towards a great raft of the same birds which seemed to cover the water inshore and somewhat in advance of us. An endless triple line flew past us during the morning, crossing ahead and merging with the tremendous flock which made the ocean look brown. The flock as a whole was also moving southward, with the rear birds rolling over those in advance. Eventually it outstripped the steamer and became lost to sight in the direction of the valley of Chicama.

We made out the heights of San Lorenzo Island early in the evening of September 10th, and within an hour came to anchor in the harbor of Callao. Next morning the sights of the busy port lay before us, but all eyes looked over and beyond it, across the flat, gently sloping, green floor of the Rimac Valley, to dimly-seen Lima, lying against cloudy spurs of the cordillera. After leaving our passengers from Paita at the quarantine station on San Lorenzo, we steamed in toward the fleet of waiting launches, and immediately a scene of mad confusion assured us that our first welcome was at least to be a hearty one. With long boat-hooks the *fleteros*, who transport passengers and baggage to the custom-house landing, attached their small craft to the moving steamer, and others in turn hooked on to those who had first obtained a hold, until we were towing the whole flotilla at the im-

minent risk of swamping most of the boats. At the first possible moment the piratical fleteros rushed up the lowered steps, overpowering the purser and guard, and practically taking the 'Mantaro' by storm before the port officers had even received the vessel. Within a twinkling many passengers were likewise overpowered, in only a slightly more persuasive manner, and precious trunks and bags were soon being lowered by means of precarious lines to the waiting boats. The landing stairway, jammed with struggling boatmen and sailors, was nearly overturned by the swell of the sea and the wild tugging of the clustered boats below. The steamer's officers roared in vain; order and discipline had gone to the winds; it was each fletero for himself and devil take the passenger.

CHAPTER III

GUANO AND ITS PRODUCERS

NEARLY a month had passed after my arrival at the capital before it became possible for me to embark for my first base upon the guano islands. Señor Ballen, director of the *Compañia Administradora del Guano*, had placed every opportunity and facility at my disposal, including the hospitality of the guardians' buildings upon the islands, and the use of launches and other craft. Provided with credentials to the authorities at all islands, lighthouses, and ports of the Republic, I went aboard the steam trawler 'Alcatraz,' on the morning of October 7, 1919, and we started northward from the bay of Callao into the gray, gently-heaving Pacific.

Garua had been falling in Lima when I left the city early in the morning, but the atmosphere over the ocean was clear and dry. Great numbers of sea-birds were about, from the harbor of Callao northward as far as we could see—gannets, pelicans, cormorants of three species, several kinds of gulls,

and fluttering groups of the exquisite, white-moustached, coral-billed Inca terns or *zarcillos*. As soon as we were well off the land, Cape pigeons, shearwaters, and diving petrels or *potoyuncos* appeared, as well as good sized flocks of phalaropes, which had migrated to this coast from Hyperborean breeding grounds.

The Scotch-built trawler, 'Alcatraz,' upon which I had taken passage as the guest of the guano administration, was bound first to Huacho, 53 sea miles north of Callao, from where it was proposed to tow a guano-carrying schooner on the windward reach to the Chincha Islands. Captain Agostin Tassi filled a commodious arm-chair in the little steamer's stern all morning, good naturedly pointing out the landmarks of the varied coast, and telling rapid-fire tales about the birds and the lobos, which would doubtless have been highly entertaining if I could have understood a larger fraction of what he said. At noon we steamed between Mazorca and the guano-whitened rocks of Salinas Promontory, passing close to arched and caverned islets of the Huaura cluster, some of which were covered with breeding guanayes. Many pelicans occupied a small flattish rock south of Salinas Bay, and hundreds of others were standing statuesquely against the cliffs of the opposite shore. Inland, beyond the terraces and dunes, one could see that the upper slopes of yellow hills were thickly sprinkled with matted growths of the sand-binding,



MID-AFTERNOON AT CENTRAL CHINCHA ISLAND, WHEN SPREADING FLOCKS OF
GUANAYES BEGIN TO BLANKET THE HILLTOP.



THE AMPHITHEATRE, NORTH CHINCHA ISLAND, WITH ITS BOXES AND BALCONIES
OF NESTING PIQUEROS.

bayonet-leaved, almost rootless plant (*Tillandsia purpurea*), related to the pineapple, which I had found previously upon the Morro Solar.

The day continued cloudy until the first lap of our voyage was nearly ended, although the water towards the offshore horizon was brilliant sapphire beneath paler blue windows in the gray sky. In late afternoon the sun burned through the veil, enlightening the rosy dreamland of Beagle Mountains, named for the famous brig of Fitzroy and of Darwin, which tower to a height of 4,000 feet behind Salinas Bay. The warm, slanting beams also made the gulls in two vast, high flocks to the eastward shimmer like snowflakes. One flock, numbering certainly more than a thousand birds, approached the 'Alcatraz,' and the birds settled in dense formation on the sea so near to us that I could identify them as Franklin's gulls, winter wanderers from the western states of our own country, and one of the friendly group to which the Mormons have erected a monument in Salt Lake City in grateful remembrance of their grasshopper-eating services for the early pilgrims to Utah.

An hour before sunset a shoal of porpoises joined the 'Alcatraz,' and accompanied us in continually increasing numbers until we dropped anchor in Huacho Bay. They were beakless porpoises, with very pointed snouts, and the white color of the belly and flanks extended across the head in front of the eyes. Troupes of them, sometimes as many as

twenty-five together, raced along barely ahead of the trawler, so that their tails were in the foam from the cleaving stem. Their lithe bodies wound in and out among each other as they shot now up, now down, or swayed from side to side with the indescribable grace born only of water. When turning sharply they rolled on their sides, and frequently one would roll completely over without decreasing its speed or losing its place in the formation. The flukes of their tails seemed so rigid, so immobile, that it was hard to realize that they were the source of propulsion. Indeed, the beautiful, interweaving play made it appear that the fishlike beasts torpedoed through the water with a velocity not issuing from muscular energy. I have never seen creatures which gave the impression of fun, and the joy of life, more than they, and even members of the crew of the 'Alcatraz' watched their evolutions with rapt delight. Presently the steamer and the vanguard of porpoises ran down a potoyunco on the water. The startled petrel dived right in front of a line of well-toothed jaws, but from my position directly above I could see that the porpoises ignored it. My last impression was of a frightened, submerged bird, with widely spread feet, disappearing under the "bone-in-the-teeth" of the trawler's bow.

Porpoises evidently entered into the bill-of-fare on board the 'Alcatraz,' for many strips of the dark flesh of these animals were suspended above the

pilot house. According to the black Colombian cook, the meat should hang for a fortnight in the open air before being eaten.

The sun had passed below the cloud-banks into a band of clear sky when we dropped anchor in the roadstead off the barrancos of Huacho. As the trawler swung about, the wind, which had not been perceptible while we were traveling before it, could be felt as a brisk breeze. The guano schooner 'Ballestas,' for which we had come, lay close by, and a San Francisco barkentine was unloading a product for which coastal Peru depends entirely upon ships from other lands, namely, lumber. Numerous fishing boats, with expectant sea-lions astern, were at work in the bay, and at evening lines of seabirds could be seen against the lighter west, hurrying homeward.

The slow, windward trip to the Chincha Islands, with the foul-bottomed 'Ballestas' in tow, was one of never-failing interest, although marked by no striking event. We left Huacho in the forenoon of October 8, and passed through the Boqueron of Callao, between San Lorenzo Island and the mainland, shortly before dawn of the next day. Captain Tassi chose this tortuous and relatively dangerous course in order to avoid the full strength of the Humboldt Current, which, he said, was running strongly in the outside route. That active oceanic circulation of some sort was in progress all along our way was indicated by many parallel foam-lines,

which formed an angle with the coast, and by rapid though slight changes in the temperature of both air and sea. At frequent intervals I lowered marine thermometers into the surface water, and at night my lines came up all twinkling with fiery spots of the ocean phosphorescence.

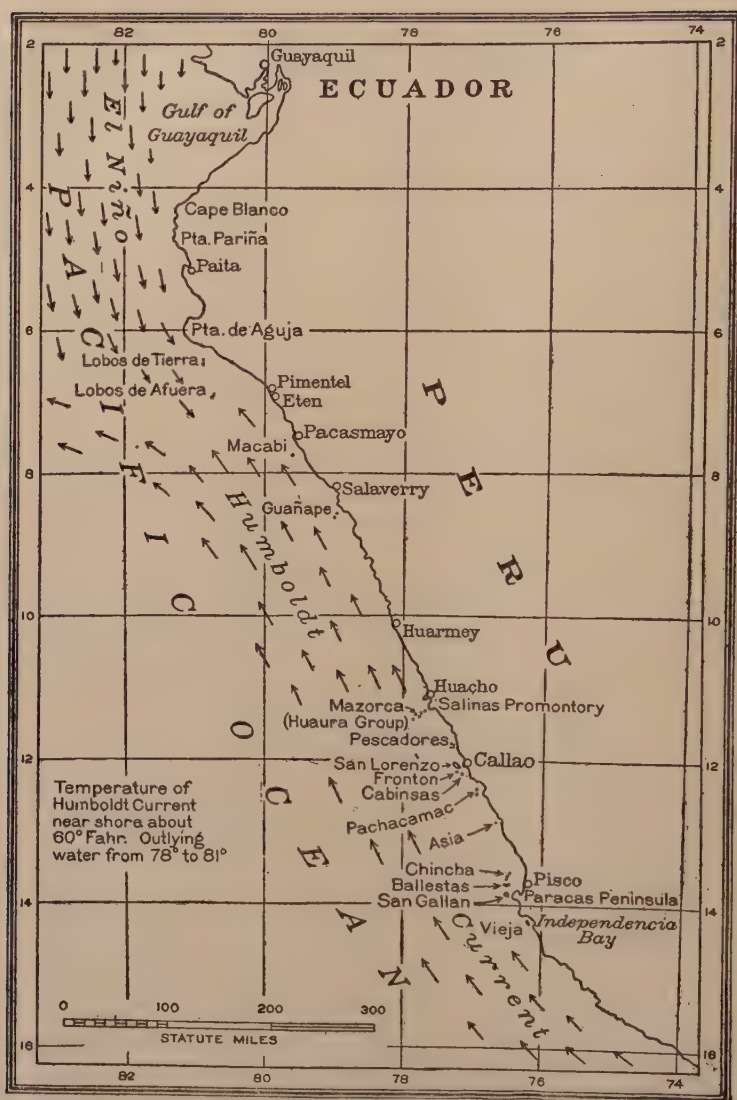
During the second day, while we steamed along the coast between Pachacamac and Cerro Azul, and not far offshore from Asia Island and other important guano deposits, we ran through many "slicks" or glassy areas on the sea. They lay mostly between the foamy drift-lines, and were themselves usually more or less flecked with suds and bubbles. These slicks proved to be the feeding grounds of flocks of northern phalaropes, aggregating tens of thousands of birds. This species of swimming snipe, which breeds in the arctic parts of North America, had apparently never before been recorded from the southern hemisphere. Its winter home had been, in fact, unknown, although correctly assumed to lie somewhere in the oceans south of the equator. The phalaropes that we encountered were shy and restless, usually taking wing when the 'Alcatraz' drew near. During subsequent field work I found them to be common all along the coast of Peru.

At three o'clock on the morning of the 10th, I was awakened by the slowing down of the ship's engines, and, going on deck, I saw the three Chincha Islands a mile or so ahead. At daybreak

we cast off the 'Ballestas' in the north channel, and then skirted the grottoed shore of Central Island to an anchorage abreast the headquarters of the guano administration. The endless, undulating and interlacing files of guanayes were flying overhead across the strait; gannets and zarcillos were fishing up and down the green waterways; a gray fulmar floated lightly near by; penguins loafed at the surface; and lobos were wallowing and jumping clear out of water. The prospects were everything that a naturalist could desire.

The Chincha Islands, which make up part of the outer border of the Bay of Pisco, formerly contained the most notable deposits of Peruvian guano, not only because of the great quantity of the valuable substance which had accumulated here, but also because ancient Chincha guano had retained a higher percentage of nitrogen, the chief fertilizing element, than the guano of the Lobos Islands in the somewhat less arid region of northern Peru.

Guano owes its value to the peculiar manner in which its components are united, by the alchemy of the bird's intestinal tract, into a compound more easily absorbed by plants from the soil to which it is applied than any fertilizer synthetically composed. To put the matter as simply and forcibly as possible, it may be said that, if the value of fertilizer be calculated according to nitrogen content, the best Peruvian guano is more than thirty-three times as effective as farmyard manure.



Courtesy of *The National Geographic Magazine*

Sketch map of the Peruvian coast, showing the prevailing oceanic circulation and the position of the principal islands.

In the literature of the subject, Peruvian guano has been often called "the deposits of birds and seals," but that the contribution of the latter animals is negligible, at least as to quality, has been shown by Dr. R. E. Coker.

It is not within the purpose of this chapter to recount the early history of guano exploitation, or to revive tales of the unfortunate period between 1849 and 1884, during parts of which the rulers of the Peruvian Republic attempted to conduct a government without recourse to taxation, persistently meeting the financial needs of the nation by mortgaging future income from the supposedly exhaustless supply of fertilizer. Nevertheless, I wish to quote an excellent epitome by Dr. Coker, which will indicate the fundamental importance of guano to Peru and the condition to which the great national resource had been reduced by a commercial and financial bacchanal of sixty years' duration.

Centuries before the beginning of modern American agriculture, there existed on the west coast of South America, a civilization of high attainments in agriculture, in textile industries, and in architecture.

The ancient Peruvians found their westward land a vast desert . . . except for a few narrow and fertile valleys traversed by inconstant streams. They might have confined their farming operations to the shores of these natural water-courses, but, as an aggressive and intelligent people, they extended their cultivated fields far over the naturally arid wastes.

This they accomplished by developing a science of agricultural engineering, marked by extensive irrigation works, with canals and ditches that followed the contours of hillsides, tier after tier, or pierced sharp ridges with remarkable tunnels.

The great obstacle Nature had placed in the way of their agriculture being overcome, they found upon the coast and islands a unique compensation for their difficulties. The same conditions which made the lands naturally arid had also conserved to them the best of agricultural aids in Peruvian guano.

They took fertilizer from the islands to enrich the lands, even in the high altitudes . . . two or three miles above sea-level. Incidentally they left in the kitchen-middens of the camps upon the islands, relics of pottery and metal-ware suggestive of an origin of the guano industry dating back at least to an early period in our Christian era.

These early Americans appreciated the value of the producing birds, and they not only enacted most rigorous edicts for the protection of their feathered benefactors, but, according to the account of the Inca Garcilasso de la Vega, they so administered the industry of guano extraction as to make possible the effective conservation of the resources with which Nature had endowed them.

With the Spanish conquest and the consequent decline of agricultural and industrial life, the guano industry fell away to a condition of insignificance until near the middle of the last century. . . .

Up to about 1840 . . . the beds remained virtually undiscovered to the foreign world. Existing then in practically undiminished quantity, the deposits represented the accumulation of thousands of years, lying in thick

beds, exposed or deeply buried, and waiting only to be shoveled up and loaded into ships for conveyance to the markets of the world.

After guano was actually introduced to the foreign markets, about 1843, there began an era of extraction on a scale hitherto unknown. Islands were surrounded by vessels, fifty or more at a time, and each year saw the disappearance of hundreds of thousands of tons.

It is stated that more than ten million tons were extracted between 1851 and 1872 from one small group of islands, representing an average annual exportation to the value of twenty or thirty millions of dollars. A single island, it is said, was lowered more than a hundred feet by the removal of its thick crown of guano.

The possibility of exhaustion of the deposits was not then contemplated, and no thought was given to conserving the birds.¹

The result of long years of mismanagement and unsound methods was that at the close of the nineteenth century Peru found her guano deposits reduced to such a point that the country's agriculture was threatened, besides which control of the remaining supply was largely in the hands of foreign creditors. The prospect for an increment of new guano was, moreover, extremely dark, because the welfare of the birds, which are the manufacturers, had been ignored; they had, indeed, been disturbed, driven away, or even wantonly slaugh-

¹Coker, *The National Geographic Magazine*, June, 1920, pp. 539-543.

tered, to such an extent that the repletion of their numbers seemed unlikely.

The rehabilitation of guano traffic, the conversion of an exploitation into a true industry, the repopulation of the barren rocky islands with colonies of birds whose numbers may be compared with those of the flocks protected by the aboriginal Indians, and the building up from the wreck of the past of the greatest of all business enterprises based upon the conservation of wild animals, is an inspiring story of modern Peru. In the short space of fifteen years the larger part of the change has been accomplished. The contract system of guano extraction, with its cut-throat competition and waste, has been abolished, and control has been centered in the national guano administration, the policy of which makes immediate advantage secondary to a rigid protection of the birds upon which future resources depend. Only two islands, Lobos de Tierra and Lobos de Afuera, remain in bond to a private corporation which, as a creditor of the government, is still entitled to extract and sell several hundred thousand tons of guano. But as soon as the old debt has been cancelled, these stations will likewise revert permanently to national administration which, in the meanwhile, exercises the right of supervision over the birds upon the leased islands.

While credit for the reorganization belongs in the main to the far-sighted and patriotic citizens of

Peru who succeeded in pushing through the necessary legislation, the influence of at least two foreign experts must by no means be over-looked. One of these is Dr. Henry O. Forbes, whom I have mentioned in a previous chapter, and who, in 1913, after several months of personal work under the joint auspices of the government and the Peruvian Corporation, made a detailed report on the guano birds to President Billingham. The other is Dr. Robert E. Coker of the United States Bureau of Fisheries, who, through a long series of publications in both Spanish and English, has recorded the observations and constructive conclusions of his scientific studies for the government of Peru during 1907 and 1908. More than any other individual, moreover, Dr. Coker has made the natural history, fisheries and guano industry of the Peruvian coast familiar to the general reader as well as the specialist. Both Coker and Forbes gave their advice at a time when it seemed unlikely to be followed, but subsequent action was undoubtedly affected by the work of these two pioneers.

The first undertaking of the guano administration, under the able directorship of Señor Francisco Ballen, was to make each of the numerous islands a bird sanctuary, closed at all seasons of the year to unauthorized visitors. Competent guardians, with duties scarcely less exacting than those of lighthouse keepers, were posted as residents upon every group. Clandestine guano extraction, the

stealing of eggs for food or for the use of the albumen in clearing wine, and other depredations which had formerly caused havoc in the colonies, ceased at once. The old method of extracting guano without regard to the presence or condition of the birds has, of course, been abolished. The islands, under the new rule, are worked according to a system of rotation which leaves ample and congenial breeding grounds always available. Courting or nesting birds are shielded with particular care. Moreover, after removal of the guano, an island is promptly vacated and is thereafter given over to the complete possession of the birds for a period of approximately thirty months, at the expiration of which the date for a renewal of digging operations is determined only after thorough reconnaissance.

The creation of a technical section of the guano administration, in charge of an agricultural engineer, Señor J. A. de Lavalle y García, has resulted in important scientific work upon the islands, including meteorological and zoological investigations, and a detailed study of diseases of the birds. The same department has also conducted a progressive advertising campaign in order to make the value and availability of guano familiar to planters throughout the Republic.

The régime of the guano administration, with its well balanced regard for both business and conservation, has resulted in a nearly uniform growth in the increment of natural fertilizer. Ten years



THE GUANO WORKERS' SIESTA, CENTRAL CHINCHA ISLAND.



GUANAYES ON THEIR TWELVE-POUND NESTS, PESCADORES ISLAND.

ago the annual output was less than twenty-five thousand tons, while to-day it is about ninety thousand tons of which seventy thousand are used in Peru and the remainder exported.¹ Even the latter figures may seem small when compared with the many million tons of guano shipped from the Peruvian islands during the latter half of the 19th century. But the old exploitation only drew upon the deposits of past ages, with a constantly diminishing return, while the new method builds up its future as it goes. The guanayes, as well as birds of lesser importance, are rapidly repopulating the ancestral breeding grounds. Unless quite unexpected circumstances intervene, it is probable that the impressive, streaming flocks, which alone connote a healthy and productive condition of the guano-making colonies, may always be seen along the famed seacoast of the Incas.

¹The Compañía Administradora del Guano is capitalized at \$1,000,000, and possesses extensive equipment, including nine cargo vessels, a tug, four motor launches and numerous barges and smaller craft. Guano is shipped to every port of the Republic, and is used in the cultivation of a variety of crops, although sugar cane claims the greater portion. During the fiscal year ending March 31, 1920, 220 planters and corporations purchased guano for use in Peru, the quantities ranging between 2 and 3500 tons, with an average of about 335 tons. The sale price is fixed by law as follows: from each ton of 920 kilograms the government derives a revenue of \$1.25 per unit of nitrogen. If average analyses of one shipment of guano, for instance, indicate 12 per cent. of nitrogen, the federal impost amounts to \$15.00 per ton. To the latter sum the Compañía Administradora del Guano adds the cost of extraction, loading, transportation, insurance, public benefit tax, etc., plus a uniform profit of 10 per cent.

Many species of birds have contributed to the accumulations of Peruvian guano, and at various times one kind or another may have successively assumed the position of leading importance. Even within recent years the relative ranks of at least two species have changed order, and there is much evidence to show that factors which probably include not only human interference, but also aberrations in oceanic circulation (such as might affect the food supply), and the occurrence of disease among the birds, have caused changes in the avian population at various groups of islands. But, notwithstanding the reports of certain early observers, which attribute leading rôles as guano producers to penguins, diving petrels and other birds that are to-day almost negligible, it seems certain that in the past as well as at present first place has generally been occupied by three or more species of the single order known as the Steganopodes, the group which includes the cormorants, the pelicans and the gannets or boobies. These birds are, of course, fish eaters. The vast supply of Peruvian guano is therefore ultimately dependent upon the chain of life which is described in the chapter on oceanography. A striking picture of the abundance of the guano birds, and of the anchovies and other marine organisms in this chain is given by Coker:

In contrast to the barrenness of the coast [of Peru] there is a peculiar wealth of certain forms in the open

ocean. The great red seas, formed sometimes, at least, of myriads of microscopic dinoflagellates are of common occurrence. . . . Sometimes, too, great areas of the surface of the sea are reddened by the vast numbers of small crustacea (*Munida*), which then play a part of great importance as food for the fishes and for the guano-producing birds. More striking still are the immense schools of small fishes, the "anchobetas" (*Engraulis ringens* Jenyns), which are followed by numbers of bonitos and other fishes and by sea lions, while at the same time they are preyed upon by the flocks of cormorants, pelicans, gannets and other abundant sea birds. It is these birds, however, that offer the most impressive sight. The long files of pelicans, the low-moving black clouds of cormorants, or the rain-storms of plunging gannets probably can not be equaled in any other part of the world. These birds feed chiefly, almost exclusively, upon the anchobetas. The anchobeta, then, is not only . . . the food of the larger fishes, but, as the food of the birds, it is the source from which is derived each year probably a score of thousands of tons of high grade bird guano. . . . No more forcible testimony to its abundance could be offered than the estimate, made roughly, but with not wide inaccuracy, that a single flock of cormorants observed at the Chincha Islands would consume each year a weight of these fish equal to one-fourth of the entire catch of the fisheries of the United States.

In the course of my narrative, I refer frequently to the immense flocks of guano birds which never fail to astound and delight visitors to the Peruvian coast. Below is a vivid account of a characteristic

scene witnessed in November, 1918, by Dr. Frank M. Chapman of The American Museum of Natural History.

There is doubtless no area of equal extent in the world with a larger sea-bird population than the waters off this coast. Throughout its entire length of some 1,200 miles, birds are always present in large numbers, and when some unknown cause induces the small fish on which they feed to appear in a comparatively restricted area in incalculable myriads, there is a corresponding concentration of the feathered forms which prey upon them.

On November 20, when we were anchored off the port of Salaverry, it was obvious that we were in the center of such a gathering. Whether one looked north, east, south or west, birds could be seen in countless numbers passing in endless files, fishing in dense, excited flocks or massed in dark islands on the sea. If one looked toward the shore, where the bare, blazing sand-dunes smothered in smooth banks the base of coastal hills rising dark and desolate behind them to be in turn overtopped by the distant Andes long, waving, whip-like streamers and banners of birds passed in endless undulating files, sharply silhouetted against the atmospheric mountains.

Seaward like aërial serpents sinuous lines crawled through the air in repeated curves which lost themselves in the distance, or processions streaked the sky or water in rapidly-passing, endless files, flowing steadily by, hour after hour, during the entire day without ceasing and with but slight breaks in the line. At times the flocks were composed of Cormorants, with, at intervals, an occasional white-bodied, brown-winged Booby. At others,

they would be made up almost wholly of Boobies, accented here and there by a Cormorant, while for an hour or more Cormorants were passing northward some forty feet above the sea, and below them, low over the water, Boobies were flying southward, the head and tail of each procession being beyond the limit of vision. The Booby formation was less regular than that of the Cormorants, three or four birds often traveling abreast, and they passed at an average of three hundred per minute. It was not possible, however, to estimate from such observations the number of birds which passed a given point during the day, since the direction of flight was at times reversed as the birds sought new fishing grounds.

These were near the shore, and the focal points toward which sooner or later the birds converged, resulted in a scene to which no description can do justice. There was not a passenger aboard the ship who did not express his lively interest in it, and throughout the day it commanded untiring and often excited attention.

The Cormorants fished from the surface, where they were evidently surrounded by a sea of the small fry, which, with much plunging and diving, they gobbled voraciously, until, their storage capacity reached, they rested in great black rafts on the water, waiting for the processes of digestion to give both excuse and space for further gorging.

The Boobies fished from the air, plunging headlong and with great force from an average height of fifty feet into the water almost directly. Like a great flying spear-head they strike the water and disappear in the jet of foam which spurts upward as they hit the surface. It is a more thrilling, reckless performance than even the plunge of the Fish Hawk. The dive of a single

Booby, like that of the Hawk, is always a notable exhibition of skill, strength and perfection of the winged fisherman's art. Only a person rarely gifted in the use of words could adequately describe it. How, then, can one hope to paint a pen-picture of a thousand Boobies diving, of a skyful of Boobies which, in endless stream, poured downward into the sea? It was a curtain of darts, a barrage of birds. The water below became a mass of foam from which, if one watched closely, hundreds of dark forms took wing at a low angle to return to the animated throng above, and dive again; or, their hunger satisfied, they filed away with thousands of others, to some distant resting place. It is difficult to understand why the birds emerging from the water are not at times impaled by their plunging comrades and how the Cormorants, always fishing on or near the surface, escape. But the most amazing phenomenon in all this amazing scene was the action of flocks of Boobies of five hundred to a thousand birds, which, in more or less compact formation, were hurrying to join one of the Booby squalls which darkened the air over the fishing grounds. If, unexpectedly, they chanced to fly over a school of fish, instantly and as one individual every Booby in the flock plunged downward and in a twinkling the air, which had been filled with rapidly flying birds, was left without a feather! This spectacle, the most surprising evolution I have ever seen in bird life, was witnessed repeatedly during the day.

We left Salaverry late in the afternoon, when the setting sun revealed an apparently endless succession of mountain ranges leading to the far-distant Andes, and seemed to light each with a different color—gray, pink, brown or purple—and the birds were still waging active



PELICAN CHICKS OF LOBOS DE TIERRA.



Motion picture film.

NESTING PELICANS NEAR THE DOCK, LOBOS DE AFUERA.

warfare against the inhabitants of the waters. But I could look at them no longer without experiencing a feeling of confusion and dizziness. For the first time in my life I had seen too many birds in one day.

At the present time, four species, comprising one cormorant, one pelican and two gannets, belong in the category of important guano producers. One of the gannets is confined to the northernmost Peruvian islands, and is of much less value than any of the other three birds. In order of increasing economic importance, the members of this distinguished quartet, with their Peruvian and scientific names, are as follows:

1. The camanay (*Sula nebouxi*), a tropical gannet or booby.
2. The alcatraz (*Pelecanus thagus*), a pelican peculiar to the Humboldt Current.
3. The piquero (*Sula variegata*), a booby peculiar to the Humboldt Current.
4. The guanay (*Phalacrocorax bougainvillei*) a white-breasted cormorant peculiar to the Humboldt Current but of antarctic affinities.

The *camanay* is the "blue-footed booby" of American ornithological books, and the only one of the Peruvian guano birds which belongs also to the fauna of North America. Unlike the guanay, alcatraz, and piquero, it is not a characteristic species of the cool-water belt of western South America. Its range, on the contrary, is confined

rather definitely to the tropical zone between the southern waters of the California Current and the northern extremity of the Humboldt Current. Although it is credited in ornithological works with inhabiting the Pacific "between Lower California and Chile," it is, as a matter of fact, a relatively rare bird south of northern Peru, and it apparently finds its southernmost breeding limit at Lobos de Afuera ($6^{\circ} 58' S.$). A considerable colony occupies a headland on Amortajada Island, in the Gulf of Guayaquil; other breeding grounds are known on the Galápagos, where Mr. Beebe recently encountered the species, and thence northward to arid islands within the Gulf of California.

Although reckoned the least important of the guano birds, the camanay, through years of undisturbed breeding at Lobos de Tierra, has increased enormously in numbers. The European war proved a boon to this species, for the scarcity of suitable cargo vessels, and the high cost and uncertainties of ocean freightage in general, long deterred the Peruvian Corporation, which alone holds the right to export guano, from conducting any excavations.

The camanay is not a colonial bird, strictly speaking, but in many of the flat, detritus-filled valleys of Lobos de Tierra its nests are now so thickly distributed that the total increment of guano is very large. It is hard beset by an extraordinarily abundant enemy, the *cleo* or kelp

gull, which devours its eggs; but since it is the boldest and most pugnacious of all the guano birds, it is well able to defend itself successfully, and I doubt whether its increase is to be limited by any other factors than the supply of food, space for reproduction, and the nature of the consideration it may receive from human beings.

The *camanay* is a slightly larger bird than its relative the *piquero*, from which it differs also in coloration, the head, throat and upper breast being more or less overlaid with cinnamon brown. Its large, webbed feet are of an unbelievably bright blue color, which gives it an extremely bizarre, almost grotesque, look. The females weigh three and three-quarter pounds, and exceed the males in size. More striking sexual differences are revealed by the yellow eyes, which, in the female birds only, have huge, somewhat star-shaped pupils. Still more impressive is the dissimilarity of voice in the two sexes, for while the males express their emotions by mild and pleasing whistles, the utterances of the females are strident, raucous trumpetings.

The *alcatraz* is one of the largest of pelicans, with a weight approximating 15 pounds, and exceeding in size the North American white pelican. In feeding habits and appearance, it resembles rather the brown pelican of southern North America, although its coloration is subject to very extensive variation due to age and other causes. The white or yellow head, with a tuft or topknot, the yellow

necklace, dark brown nape and the blue, green, yellow and orange or reddish hues of the great bill and pouch, are striking marks.

There is reason to believe that in past times the alcatraz was an extremely important guano producer, perhaps even the bird of first rank at certain of the islands along the whole length of the Peruvian coast, and also upon parts of the mainland. Even as recently as the visit of Forbes (1912), alcatrazes bred in large numbers upon the Chinchas and other islands in the bay of Pisco. Coker, whose investigations were made from four to six years earlier, assigned to the species the position of second importance, although he found it abundant at only the northern islands.

To-day the alcatraz deserves no more than third rank as a producer of guano, for second place has been securely occupied by one of the gannets. The decline of the alcatraz has undoubtedly resulted from human interference, to which it is the most susceptible of all the guano birds. It is invariably the quickest to abandon its nesting grounds if molested, and, in my opinion, is by all odds the least practicable of the birds from an industrial point of view.

During my field work, small groups of breeding alcatrazes were noted upon a few of the southerly islands. At Lobos de Tierra, in northern waters, there were eight well distributed colonies, none comprising more than two hundred pairs of birds.

Lobos de Afuera, the present headquarters of the species, supported an impressive aggregation, which may have numbered 200,000 birds, upon the northern half of the western island. This magnificent colony can be saved from diminution or extinction, and can be made to yield a perpetual supply of guano, only if extraction be conducted in such a manner as to leave one of the two main islands of Lobos de Afuera always undisturbed.

The range of the alcatraz is practically identical with that of the guanay and piquero. Like these birds, moreover, it reproduces throughout the year, although less prolifically during the winter season, May to September.

Piquero is the Spanish word for lancer, an appropriate appellation for this gannet, whose spectacular plunges are familiar sights throughout the length of the Humboldt Current. It is the most abundant of the guano birds, and, as a producer of available fertilizer, it has undoubtedly won the place of closest rival of the guanay. Piqueros nest mostly upon the cliffs and pinnacles of the islands, but, with the reduction in the alcatraz population, they have taken to spreading over the flat surfaces, or *pampas*. Curiously enough, early observers, such as the Peruvian naturalist, Raimondi, have recorded that formerly these gannets nested habitually in the central parts of the islands. All modern visitors, however, have found them to be typically, and almost exclusively, cliff-dwelling

birds, and their reinvasion of the insular tablelands is certainly a very recent development. I noted the interesting fact that piqueros nesting upon level ground were shyer and more susceptible to fright than those occupying the normal environment of the cliffs.

In 1919-1920, piqueros were found breeding upon all of the islands visited, but in very small numbers to the southward of the Ballestas group. At the Chincha Islands, and, more especially, at Lobos de Tierra, many were nesting upon areas of flat ground, while the south Gunaípe island was occupied exclusively by this species.

The piquero is a white-bodied bird, with variegated brown wings and back, a red eye and bluish bill and feet. Adult specimens weigh between three and three and a half pounds. A single piquero produces as much as five ounces of guano in a day. If one ounce of this (a low estimate) were deposited on an island, a thousand piqueros would produce nearly eleven and a half available tons a year, or a million birds 11,400 tons—three quarters of a million dollars' worth.

The piquero is in all ways a less sensitive and more adaptable bird than the alcatraz, and in future the relative standing of the two is certain to swing more and more in favor of the former.

As for the guanay, it stands in a class by itself, and is of such importance that a special chapter must be devoted to it.



A LEDGE-FULL OF PIQUEROS ON THE SHEER FACE OF A NORTH CHINCHA CLIFF.

CHAPTER IV

THE MOST VALUABLE BIRD IN THE WORLD

THE title of this chapter is a statement of opinion, not a claim to omniscience. What mortal can appraise a living creature? Which of the 18,000 or more existing kinds of birds that gladden every land and sea can be called most valuable, and upon what criteria?

Excluding from the reckoning domestic poultry of all sorts, as well as the stork which, wherever European tradition holds sway, is saddled with the responsibility for our very existence, we may cast about almost at random and might consider, for example, the swallows which spend their days in ridding the air of insects that in one way or another are detrimental to the growth of vegetation. With less satisfaction but equal justice, we might turn to vultures and other scavengers which, throughout the tropics and large portions of the temperate zones, clear away carrion which results from the common fate of all animals. We should have to

take account also of many important game birds, sources of sport and food to myriads of human beings; of woodland dwellers such as the jays which directly or indirectly plant forests; of the hummingbirds which, aside from being incomparably beautiful feathered creations, fertilize in the American tropics the loveliest of all plant forms, the orchids. Nor may we omit to think of the egrets and birds of paradise, victims of an immeasurably large traffic, which pay with their blood for the value man sets upon them.

And yet few would admit that the qualifications of the birds mentioned weigh heavily in the balance against those of more familiar kinds which in all parts of the populated earth have from time immemorial endeared themselves by their never-failing seasonal presence, their boldness, their beauty of voice or color, their exemplary parenthood, or even by the seeming possession of such foibles as mischievous or irritable temperaments, with which man can sympathize because he so well understands them.

Therefore, lest our standard of worth be obliged to compete with the inspiration which Shelley and Keats derived respectively from skylark and nightingale, or which Anatole France, in a different field of letters, drew from certain flightless and extraordinarily manlike sea-fowl, it should be stated that I am here taking no account of esthetic or traditional values. Figuring in dollars and cents,

and with reference to effect upon human life and human geography, I beg to present my candidate for the post of king among avian benefactors—the Peruvian cormorant or *guanay*, known to science by the ponderous name of *Phalacrocorax bougainvillei*.

Guanay is presumably the Quichua word for a producer of guano, an implication that in ancient times as well as to-day, this species occupied a peerless position. The range of the guanay is restricted to coastwise waters along the arid, western shores of South America, between Point Pariña, just south of the Gulf of Guayaquil, and the vicinity of Corral, Chile. This stretch of shoreline, some twenty-four hundred sea miles in length, is bathed by a relatively narrow, northward-flowing, oceanic stream, the Humboldt Current, the water of which is notably cooler than that of the outlying tropical Pacific. Chiefly because of its low temperature, the Current is peopled by a probably unequaled profusion of marine organisms, including anchovies and other small fishes which are the food of the guanay, and which, because of their vast numbers, make possible a correlated abundance of the birds. The guanayes are strictly creatures of the Humboldt Current; their huge flocks move up and down the coast as the birds forage among migrating schools of fish; they breed, likewise in huge flocks, upon numerous islands lying from one to a score of miles from

the coast; but they do not stray outside the field of the Current, either to the northward or the southward or off shore.

The islets of the Humboldt Current, which are most thickly distributed along the northerly two-thirds of Peru, partake of the same desert character as the opposite continental mainland. This climatic fact is the secret of the guanay's economic importance, for the excrement of sea birds is preserved on the nesting grounds without loss of fertilizing efficacy such as would be caused by moisture.

Picture to yourself the shining, rainless coast of Peru, washed by ocean waters to which storms are unknown, where the swells surge northward, from month to month and year to year, before winds that blow regularly from a southerly quarter. On such an ocean dark flocks of guanayes form rafts which can be spied miles away. Slowly the dense masses of birds press along the sea, gobbling up fish in their path, the hinder margins of the rafts continually rising into the air and pouring over the van in some such manner as the great flocks of passenger pigeons are said to have once rolled through open North American forests in which oak or beech mast lay thick upon the leafy floor.

At other times, when the guanayes are moving toward distant feeding grounds, they travel not in broad flocks but rather as a solid river of birds, which streams in a sharply-marked, unbroken column, close above the waves, until an amazed



GUANAYES AT THE BRINK OF PESCADORES ISLAND, WITH THE MAINLAND OF PERU
BEYOND THE WATER.

observer is actually wearied as a single formation takes four or five hours to pass a given point.

Equally impressive are the homeward flights of these cormorants, after a day of gorging upon anchovies, when in late afternoon slender ribbons, wedges, and whiplashes of guanayes in single file twist and flutter, high in air, toward the rounded plateaus of white islands which gradually turn black as the packed areas of birds swell out from clustered nuclei toward the borders of the available standing room.

Whence came this astounding sea bird, which has made the Peruvian coast its own? The evolutionary history of present-day animals is in most cases impossible to decipher unless we have a clear fossil record such as, for example, that of the camels, which are known to have originated during the early part of the Age of Mammals in the western United States, where they no longer occur, and to have spread thence by diverse routes to Asia and to South America, where highly modified descendants of the North American progenitors are still found. Palæontology offers no such clue to the primeval home of the guanay's ancestors, but fortunately we can read the history of the species in other pages of Nature's text-book. For the guanay belongs to a well-defined *antarctic* branch of the cormorant family, all the members of which are characterized by certain anatomical peculiarities, as well as by external marks such as white

breasts and "warts" above the bill. The other species of this branch inhabit high southern latitudes. The guanay's nearest relatives, in fact, are cormorants of the Strait of Magellan, New Zealand, various subantarctic islands, and the shores of the Antarctic Continent all around the pole, while its relationship with other cormorants of South America, or with those of any part of the northern hemisphere, is relatively remote.

In the northward extension of this representative of an antarctic group to a point within six degrees of the equator, we recognize one of the profound effects of the Humboldt Current. The cool stream, lying between a tropical continent on the one hand and the heated surface waters of the open South Pacific on the other forms, as it were, a tongue of littoral ocean in which the environment, and consequently the marine flora and fauna, is such as ordinarily holds for the subantarctic zone rather than for equatorial or even temperate seas. This condition is more or less common to all western continental coasts, but nowhere are its results, as expressed in the distribution and abundance of life, so marked as in the Humboldt Current.

Given, therefore, a belt of cool ocean waters replete with small organisms of more or less polar type, together with nesting sites upon islands which for climatic reasons could never become encumbered with vegetation, and the geographic stage was set for the northward emigration of the ancestors

of the guanay. Furthermore, because of the normal superabundance of food, conditions seem to have been prearranged for the increase of the birds to numbers limited only by competition with other animals and by the amount of safe, insular space for reproduction. Although suitable islets are very numerous, the enormous food supply in the Humboldt Current is still out of all proportion to the area of the breeding places. This doubtless explains the excessively colonial nesting habit of the guanay, in which it surpasses all other birds, even the penguins, for in the middle of a bounteous sea there would be a constant tendency for the cormorant population to become more and more congested upon the islets. The doctrine of Malthus applies to birds as well as to men.

These facts suggest that the geographic background does not tell the whole story. Evolution is, at least in part, the result of interaction between a living being and its surroundings. The guanay itself has had to undergo considerable modification in order to fit into a new environment, especially as regards the particular character of its food in the Humboldt Current. Several such adaptive changes are apparent, changes which have progressed so far that they now strongly differentiate the Peruvian species from its antarctic cousins and from every other kind of cormorant in the world.

For instance, the guanay, unlike any other cormorant, "hawks" its food, that is it hunts

exclusively by sight and from the air, locating the fishes which it seeks before descending to the water to catch them. Most cormorants search for their prey individually, swimming alone or in loose groups at the surface, then plunging in what seem to be favorable places and conducting the hunt as well as the capture while they are submerged. For the most part, moreover, they subsist upon bottom-living species of fish, often diving down many fathoms in pursuit of single victims. But the guanay feeds altogether upon surface-swimming fishes, such as anchovies, young herrings, and the toothsome silversides which the Peruvians call *pejerreyes* ("kingfish"). Such forms travel in tremendous schools which are assailed *en masse* by proportionately large flocks of birds.

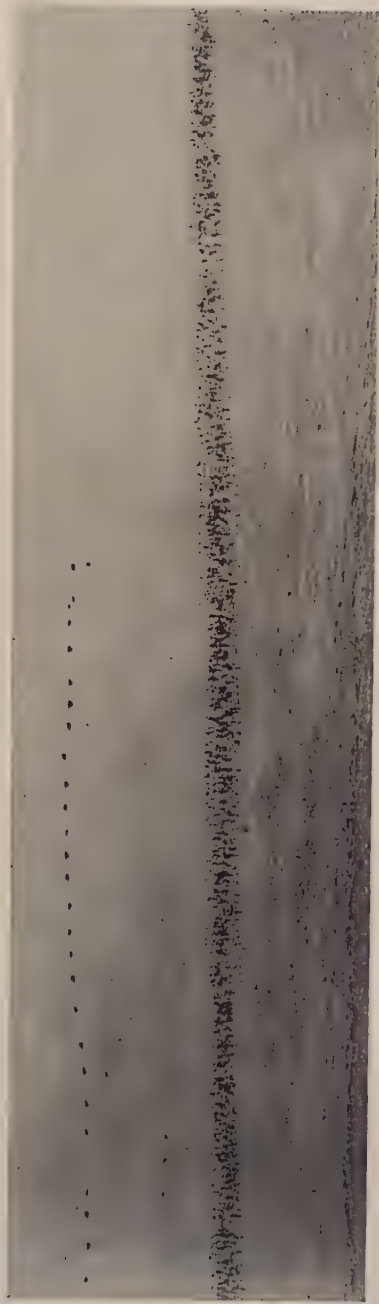
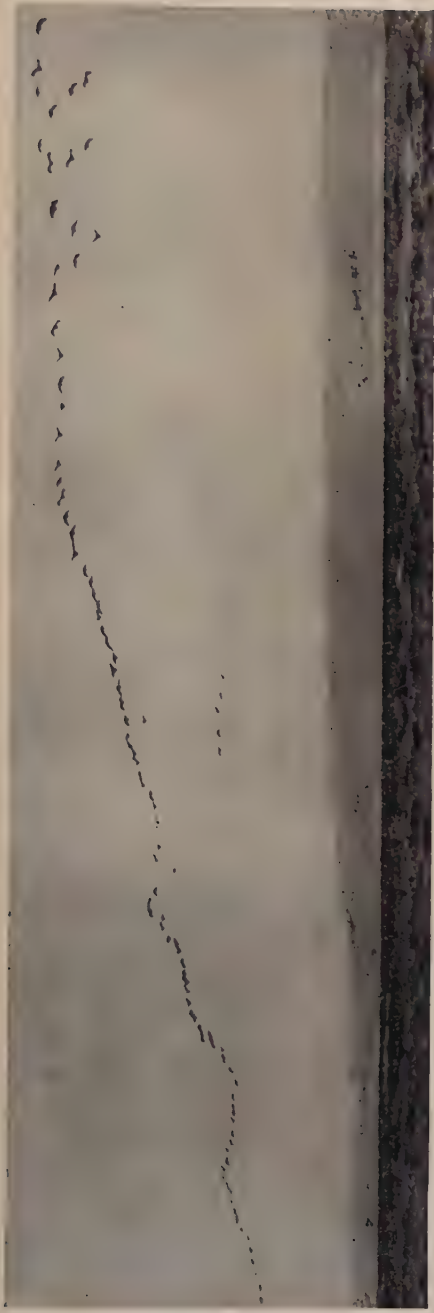
The correlation between the numbers of the fishes and the extreme gregariousness of the cormorants results among the latter in a system of efficient co-operation which almost suggests certain customs of ants or other social insects. The vast flocks of guanayes which spend their nights upon the islands do not start hunting in a body when morning breaks. On the contrary, the birds first sally forth only in small scouting parties, which can be seen flying erratically above the ocean, usually keeping well in air, and frequently "back pedalling" or hovering when they see the silvery glint of schooling fish or the ruffled appearance of the sea which indicates the presence of fish below. The

dropping of the scouts to the surface, and the shallow dives which mark the beginning of an orgy, are the signals that cause the approach of such rivers of birds as have been described above. The cohort of guanayes then spreads out as a great fan over the unfortunate anchovies, which are likely to be no less harried from beneath by bonitos and sea lions. Small wonder that the Peruvian fishermen, who are familiar with such sights, believe that the guanayes and the seals have a working understanding! However this may be, the gorging proceeds until both sea lions and birds must cease long enough to allow their rapid digestions to fit them for another meal. From the crop and gullet of a dead guanay the remains of no less than seventy-six anchovies, four or five inches in length, have been taken.

Sometimes the guanayes pursue the fishes to the very beaches, so that a rare view of a one-sided fray may be enjoyed by a landsman. One morning during my sojourn at Independencia Bay shoals of silversides were packed in deep, glittering ranks close to the quiet shore, when a raft of guanayes, accompanied by a few pelicans and a horde of screaming gulls, drove the fishes before them against the shelving sand. Soon the water gleamed like flashing quicksilver, and in wild rioting the birds jammed and crowded each other until hundreds of them were pushed clear beyond the tideline by the scrambling mob behind.

The guanay stands and walks erect, somewhat after the manner of a penguin. Its height is in the neighborhood of twenty inches and the weight of a full-grown bird about four and a half pounds. It has a glossy green and blue-black neck and back, a white throat-patch which is a conspicuous mark in flight, a white under surface, and pinkish feet. During the courtship season a crest of plumes develops at the back of the head. The guanay's iris is brown, but an area of green, naked skin surrounding the orbit makes it look at close range like a veritable personification of envy. A second ring of turgid red skin, outside the staring "green eye," heightens its extraordinary expression.

Since the fame of the guanay proceeds chiefly from sheer numbers, it is not unnatural that observers have made extremely high estimates or guesses concerning the population of its colonies. The birds breed upon the plateaus and windward hillsides of the Peruvian islands in concentrated communities, the nests averaging three to each square yard of ground. Dr. Coker's measurements show that not fewer than a million adult birds dwelt within the limits of a single homogeneous colony on South Chincha Island during one of his visits. Another naturalist has written that these cormorants "congregate to the number of ten millions." The accompanying diagram, copied from a manuscript report made by a British ornithologist, Dr.



OUTWARD AND HOMEWARD FLIGHTS OF THE GUANAYES.

Above: Waving lines of homebound cormorants, characteristically high in air, approaching their nesting grounds on Pachacamac Island.

Below: Guanayes sallying forth from the Clinchas in early morning, and flying low over the water toward a school of anchovies.



Sketch map of Central Chincha Island, showing in shading the area occupied by guanayes on January 1, 1913. Copied from a manuscript report by H. O. Forbes. A conservative estimate would place the total bird population, young and adult, at 5,600,000. Not less than a thousand tons of fish per day would be required to sustain such a colony.

H. O. Forbes, to the President of Peru, will enable the reader to draw his own conclusions.

The breeding season, like that of many tropical ocean birds, is practically continuous, but it reaches a climax during the southern summer months of December and January. In its adaptation to an all-the-year nesting habit, the species has, of course, diverged widely from the ways of its antarctic relatives, the reproductive season of the latter being rigidly fixed by the climatic cycle. Individual pairs of guanayes are believed commonly to rear two broods during a single year. The flight of the last families of the young of one season, in May or June, is at any rate followed hard by the courting

and love-making of adults in preparation for the breeding season of the second spring.

In early October, 1919, when I arrived at the Chincha Islands, the resident guanayes were in the early stages of mating. From this place and date, as investigations were carried northward from island to island, successive manifestations of the birds' life history were revealed, until at Lobos de Tierra in January, 1920, full-fledged young were observed taking to the ocean, quite independent of parental care.

At South Chincha Island in mid-October the breeding grounds were covered with just one year's accumulation of sun-baked guano, and the cormorants were getting ready to nest again. They stood in compact bodies, each comprising thousands of birds, on the flat top of the island, and, when a human being approached, all those on the nearer side began to stir—not *en bloc*, nor yet individually but in groups of a few hundred, each of which for the time constituted a unit. One group would move rapidly away, the birds carrying themselves bolt upright. Another group would advance toward the observer, so that this section of the army would gleam with white breasts instead of shiny, dark backs. Still another unit would rush to the right or to the left, so that both the dark backs and the white breasts showed at once, and the long bills and red nasal warts became conspicuous. Such closely huddled companies soon collided with others

moving in different directions, producing much confusion about the margins. A few of the birds showed no fear at all, stolidly permitting a man to approach within a few feet. The greater proportion, however, frantically took to flight, rushing helter-skelter down a slope, and raising a cloud of dust with their whistling wings. The air became bewilderingly thick with birds as they circled overhead, but within a few moments the number returning to earth once more exceeded the number taking wing.

When an observer makes his way slowly and very quietly into the heart of a colony in which nesting has definitely begun, the guanayes gradually retreat, and one may sit down in a clear circle which is at first fifty or more feet in diameter. But almost imperceptibly the birds will edge in again, until the bare circle narrows to but three or four paces. From such a point of view it seems as though the ground were covered with as many pairs of sprawling webbed feet as there is room for, and yet new arrivals plump down by scores or hundreds every minute. Over the ocean, moreover, to the north, south, east, and west, one may commonly see endless black files still pouring in toward the island. The hum of wings is like the effect of an overdose of quinine upon the ears, and the combined voices seem like mutterings of the twelve tribes of Israel. It reminds one of all sorts of strange, oppressive roarings, such as the noise of

railroad trains in river tunnels. The near-by voices, which can be distinguished individually, are merely sonorous bass grunts and screechy calls. It is the multiplication of such sounds by numbers almost too large to imagine that makes the outlandish and never-to-be-forgotten babel.

Toward evening of such October days, most of the guanayes would be courting, after strenuous hours at sea during which all their energies had doubtless been devoted to winning the sustenance of life. Privacy does not enter into their notion of fitness, and while six or seven birds occupy each square yard of ground, the love-making antics are often in full progress. These are in general not unlike the courtship habits of the closely related antarctic cormorants. Two guanayes stand side by side, or breast to breast, and ludicrously wave their heads back and forth or gently caress each other's necks. The crests upon their crowns are frequently erected, and the feathers of the nape puff out so that the velvety necks appear twice their normal thickness. Cheeks and chin-pouches continually tremble, and chattering bills are held wide open. Now and again one will bend its body forward and at the same time extend the head upside down along the spine and toward the tail, holding this curious, paralyzed attitude for several seconds. Sometimes the birds of a pair snap so much at one another that it is hard to judge whether they are making love or quarreling.

Indubitable quarrels between birds of different pairs also go on without cessation, and occasionally many join together in a *mêlée*. Every now and then, for example, some unfortunate guanay, which seems to be the butt of all bystanders, will go dashing through the throng, holding its head as high as possible in order to avoid the jabs and bites which all others direct at it. If the victim would but stop fleeing, perhaps the blows would cease, but it keeps more and more desperately running the gantlet, flapping its wings, bumping into innumerable neighbors, until eventually it bursts from the vicious crowd into a clear space, shakes itself with an abused air, and opens and shuts its mouth many times with an expression of having just swallowed an unpleasant dose.

In the early stages of courtship it often happens that several cocks select the same female for their addresses. In one instance, five assiduous suitors, all with necks expanded, were observed bowing around a single hen which crouched in their midst. But by no means all the birds are engaged in love-making at every moment, for they spend much time preening their feathers, frequently raising the coverts of the tail and thrusting the bill toward the oil gland. Then, after combing their heads and necks thoroughly with their claws—a real feat in balancing—they promenade in small troupes along the outer edge of the colony.

Visible actions, rather than unusual sounds,

alarm the courting birds. A quick motion of the hand will start sudden pandemonium. Even when an observer rises to leave them as slowly, silently, and unostentatiously as possible, a small panic inevitably results, many of the nearer birds beginning to scamper about or to take flight. On the other hand, the firing of a gun straight into the air produces scarcely a stir provided the weapon is not brandished. The effect of human conversation is, however, most amusing. Whenever a man, sitting perfectly still, begins to talk to the guanayes in a loud voice, a silence falls over all the audience within hearing. Their mumbles and grunts die away, and they listen for awhile as if in amazement.

During the course of a few hours' resting on any island, the birds get much befouled with fresh guano, which hardens upon their plumage. They periodically rid themselves of this by flying some distance off the lee side of the island where they plunge and violently beat the water with their wings. Sometimes most of the inhabitants of a colony will make their toilet in this way at one time, producing a thunderous roar which can be heard from afar. It is often audible during morning fogs, when the flocks are invisible, and as a boat draws near such a gathering it is easy to mistake the sound for the dreaded crashing of waves upon unseen rocky shores.

Inhabitants of the Peruvian coast are agreed that the guanayes never spend the night upon the

ocean, as the native pelicans often do, but that they return to their island roosting places even when the journey involves a flight which must continue long after dark. I have sometimes watched from two o'clock in the afternoon until nightfall, or for about five hours, while they streamed uninterruptedly homeward. A few piqueros often accompany them, as if filling honorary positions in the line, but fully 999 in every thousand birds are guanayes.

The grandest sight of the day, when the homeward flight is at its maximum, usually comes during the hour before sunset. From some point far away the birds make a bee line for the center of their island, but, as they near their destination, they invariably skirt the shores so as to come down across the wind. The instinct of following a leader is evidently strong; if, for any reason, a file is broken, and the rear birds turn toward the left coast instead of the right, those behind will obey the signal and all swing into the new course. Close over gulches and ridges of their home island the oncoming streams of birds flow, the separate "rivulets" cutting across each other like the blades of scissors. At the same time these files also rise and fall in beautiful undulations which can best be seen from the crest of a hill above them. Sometimes three or more such lines will flow along for a while ten or fifteen yards apart, but sooner or later one of them will make leeway until two files interweave. Then the soft, humming swish of wings is inter-

jected with sharp clicks as the quills of two guanayes strike together in air. When one beholds the endless mingling, the crossing and recrossing and tangling of the lines, it seems incredible that more birds do not clash.

It goes without saying that such gregarious creatures as the guanayes must have natural enemies to prey upon their abundance. The sea lions of the coast have been accused of devouring the fledglings when they first take to water, but, so far as my observations go, there is little evidence to support the charge. The naked, black-skinned, and very ugly chicks, which hatch from rather small greenish eggs, are apt to be thickly infested with feather-eating lice (*Mallophaga*) transferred from the plumage of their parents, and yet, so long as the sensitive nestlings are shielded from the hot sun, they seem to suffer no ill effects from these parasites. Other birds, in fact, appear to be their only serious enemies.

When I landed upon Asia Island, off central Peru, on December 4, 1919, great destruction of guanay eggs had been wrought by gulls, turkey vultures, and condors. Although a colony containing countless eggs and young still covered about half of the western slope, extending from the summit almost to the water, and filling a deep ravine as well as the rounded hillside, the other half had become a waste of empty nests and broken egg-shells, and had been deserted for the season



FEATHERY LINES OF GUANAYES RETURNING TO THE COLONY ON NORTH CHINCHA ISLAND.

by the parent birds. Early in the morning of this day, guanayes were leaving their breeding ground to pour out over the Pacific in an unbroken column which was following a school of fish in a tremendous sigmoid curve toward the north. The colony was, however, still densely peopled with home-keepers, *i.e.*, the birds of each pair which had remained to cover the eggs or the newly-hatched, squeaking chicks. The nests were luxuriantly feathered with molted quills, which, by the way, the brooding birds were forever stealing from each other's foundations. Many walked about carrying bunches of feathers, or flew elsewhere with a bill full. In the heart of the colony stood a condor, with a small circle of abandoned and rifled nests round about. When this pilferer had been shot and picked up by the feet, the albumen and mostly *unbroken* yolks of a round dozen of fresh eggs slid out of its gullet. Scarcely any pieces of shell were visible in this rich meal, the supposition being that the condors must suck the contents of the eggs through their trough-shaped tongues.

Later in the month of December, the guanayes were observed in more advanced stages of the nesting period at the Pescadores and Huaura Islands, to the northward of Callao. Here their robber-enemies were less in evidence, perhaps because the government guardians had been using their guns freely, and few empty nests or broken eggs were noted. Although a certain proportion of the adults

were incubating new sets, the latter probably represented second broods, for the nests were exceedingly large, and the quills which had once formed a lining were now buried deeply under the craters of guano which constituted the rim of each nest chamber. Moreover, nearly full-grown young, in pepper-and-salt plumage, were abundant everywhere. These chicks were inclined to be indiscreet in wandering away from their own headquarters, whereupon they would presently be chastised by old birds and would have to scurry ignominiously back to their respective home sites. Among the larger chicks the approved method of obtaining food was to shiver and plead before their elders until the latter acted as though they were frantic from the teasing. As long, indeed, as the adults were at the nests, the youngsters never let up trying to ram their heads down the parental throats, and it was nothing unusual to see two or even three dive together into a capacious and well-stocked crop. At this season the sound coming from a colony bore some resemblance to an April frog-chorus, for the high-pitched voices of the chicks tended to drown out the mumbling of the old birds.

Still older fledglings had gone down in droves to the quiet rock pools around the shores, where they flapped their wings and dived until they had become proficient in the ways of maturity. Late every afternoon thousands of these apprentices

could be seen scrambling up the steep hillsides from their training grounds, striving to get back with the crowd before dark. Such was their strange indifference to the presence of man, that they made no protest when we picked them up by their pinions and helped them on their way. This lack of fear is not necessarily innate. It may be due rather to the familiarity of the birds with guardians who never harm them, an idea suggested during a later visit to an isolated colony of guanayes on the large island of Lobos de Tierra, where both old and young were unwontedly timid, and where all the chicks that were big enough to walk left their nests pell-mell at the approach of a human being.

At Mazorca Island, of the Huaura group, a splendid colony of guanayes occupied practically all of the southern or windward slope, from the very brink of low precipices, over which the spray flew, to the crest of the island. Breeding gannets mingled to a certain extent with the cormorants along the lower border of the nesting ground. A few birds of both kinds had established themselves also on the northern slope, out of the wind, but here their enemies had been active and had succeeded in devouring many eggs. It seems to be characteristic of the vultures and gulls to attack at the edges rather than in the midst of a colony, and thus tend to annihilate projecting portions and small outlying groups. Perhaps this is one of the

evolutionary factors which have caused the guanayes to breed in such compact hordes.

The birds at Mazorca were most tenacious in clinging to their nests, even when a man stepped over them. In late afternoon many of the broods were covered by both parents, which were so huddled together that they looked like single birds with two heads. One usually had a wing, for instance, over the back of its mate. When approached, they bristled all over until their plumage resembled that of Japanese bronze eagles. They would then wave their heads threateningly, and hiss with widely opened bills.

In the forenoon the colony usually appeared thin and gray when viewed from the lofty balcony of the lighthouse; but by three o'clock in the afternoon it would be black, owing to the return of tens of thousands of additional birds. Before alighting, most of the homecomers soared back and forth considerably in the fresh breeze. Whenever one came to earth in the wrong place, it would immediately disclose its mistake by what can only be called a "lost" expression. Other guanayes in the vicinity would grasp the situation at once, and would then assault the newcomer, forcing it to take wing again at much sacrifice of dignity. It was a genuine misfortune for birds to alight where they were not welcome, for they seldom got off without being thoroughly pecked and jabbed. Such extraordinary reactions answer the question, so often asked,

as to whether colonial birds always find their individual homes among myriads of seemingly identical nest-hollows distributed over acres of undifferentiated surface. Above all else, Nature jealously guards the unity of the family; each mated pair must fulfil its own obligation of rearing offspring to maturity, and every unconscious tendency to depart from this responsibility is nipped in the bud.

CHAPTER V

THE CHINCHA ISLANDS

THE first day at the far-famed Chinchas, to which I had looked forward not only since the beginning of the expedition, but during many previous years, will ever be memorable to me. I was received cordially, as always in Peru, by Mr. Robert Reid, administrator of guano operations, and his associates; and an upper room in the combined laboratory and dwelling on the shore of the strait was placed at my disposal. It was long after midnight of a busy day before I could turn from my finally assembled equipment and begin to enter the new impressions and experiences in my notebook before retiring.

Less than a hundred feet below my balcony, small waves were swishing on the sandy cove of Central Island, and across the narrow channel the seamed precipices of South Island supported a shining top which, in the clear moonlight, gleamed like snow. Over the heights in the rear of the house, half a mile away, was the somewhat wider strait

separating Central Island from the rugged North Island, which I had seen from the hill during the day. To the southeastward, across the dark water, loomed the mountains of Paracas Peninsula, a black line against the night-blue sky; and, if I had climbed from the balcony of the building to the adjacent ridge of rock, I might have seen the fixed light of Pisco. All was now at peace upon the Chinchas, beneath the nearly full moon, but my mind could not help turning to the eventful and turbulent human history of these three tiny, bare, splintered granite rocks, which had evidently been a single island at some time in the remote past.

Small though the Chinchas are, their name is known in the farthest seaports of the world, and their share in making fortunes and abetting calamities, in debauching men and demoralizing administrations, and in serving as the inanimate cause of greed, cruelty, extravagance, economic ruin and war has given them a historic place quite out of proportion to their size. On the credit side of their account is the fact that they have supplied agriculturists of many nations with millions of tons of the most satisfactory fertilizer known. In the north channel, where one ship and two schooners lay at anchor when I arrived, a hundred square-riggers used to crowd during the mad scramble for guano. In those days, it is said, the tops of the islands were four or five score feet higher than they are at present—built up above the level of the bed rock

solely with the excrement of seabirds! The plateau of North Island, now occupied by a dense settlement of guanayes, was in the middle of the 19th century the site of a town of hundreds, if not thousands, of inhabitants. It is blotted out like Nineveh. Neither wood, nor metal, nor stone remain, and its only traces are the corpses of coolies, mummified by the guano, wrapped in their blankets, and with coins beneath their tongues. Even these gloomy reminders will soon be gone, for the present workmen pile up the old bodies when they uncover them, sprinkle them with kerosene, and burn them to ashes.

The season's guano extraction, which had commenced on Central Island in April, 1919, was nearly finished at the time of my arrival. The blanket of gray, sun-baked fertilizer, which had attained a thickness of three or four inches during the two and a half years' closure of the island, had been broken up with picks, loaded into jute sacks, and conveyed in diminutive railway cars to the brinks of cliffs, from where it was being shot down by automatic trolley, two bags at a time, into lighters in the anchorages below. After the gross scraping and shoveling had been completed, the rocky surface was thriftily swept with stiff brooms. The total yield of guano amounted to 25,630 tons, as against 21,705 tons for 1916, the latest previous year of operations at Central Island. South Island, which had been worked in 1918, had given 34,009

tons, while the most recent output of North Island, in 1917, had been 30,438 tons. It should be noted that the lowest of these figures is greater than those representing the entire harvest of guano from all the islands under the control of the guano administration during any year between 1909 and 1913.

Formerly the surfaces of the Chincha Islands were excessively rough, beneath the guano, but for several years it has been the policy to throw all loose stones over the precipices, leaving clean-swept surfaces which are well adapted as nesting grounds of the guanayes. At best, the pampa is still extremely knobby and irregular, and the jagged points of rock bruise the feet even through thick soles. Yet the Indian workmen go barefoot! All natural gullies and pits are being filled with stones and rubbish, and all rock-piles are being leveled, so that in time the Chinchas will acquire a somewhat highly groomed appearance—cultivated intensively, so to speak, for the sole purpose of furnishing nesting sites for as many pairs of birds as each square yard will contain.

It is a privilege to be able not only to give my readers an account of the Chinchas as I found them in the year 1919, but also to transmit a story reminiscent of half a century ago when the heyday of guano traffic was still a recent memory. My friend Dr. Frederic A. Lucas, Honorary Director of the American Museum of Natural History, sailed to these renowned isles on one of the long

voyages of his adventurous youth, and remained there from September 22 to December 22, 1869, while the vessel commanded by his father lay at anchor in the north strait before loading with guano for London. Dr. Lucas, who has been interested in my experiences at the Chinchas during more prosaic but happier days, has kindly written the following memoir as a historical background to the description of existing conditions.

The Chincha Islands Fifty Years Ago

Fifty years ago it was my fortune to spend three months at the Chincha Islands waiting for the good ship 'Lottie Warren' to take on a cargo of guano. The Islands were then in their decadence for the bulk of the guano had been removed; and while many thousand tons remained, yet it was as nothing compared with the amount that had been taken away. The deposits on the Ballestas and about Independencia Bay were still untouched, and San Gallan not even thought of. The greatest quantity was on the South Chincha Island, which was the most actively worked, although a considerable amount remained on the Middle Island, where a deposit 100 feet thick in a gully was opened during our stay. The North Island had been practically worked out, and here was still a good-sized town and a still larger graveyard, both later on demolished and dug out to get the last of the guano. Some of the old residents told of times when scores of ships were crowded about the Islands, and when, after lying idle for nearly three months, a vessel loaded up in three days. Our own moor-



SHIP 'LOTTIE WARREN,' A GUANO CARRIER OF 1869.

ing was almost within gunshot of one of the most famous loading places, and there were still to be seen the rings let into the rock at the place where vessels hauled under the cliff and took aboard chutes like a gigantic hose, down which in three days' time were poured a thousand or more tons of odoriferous guano.

All this was a thing of the past. Not more than a score of vessels was to be seen at any time, rarely so many, and all guano was laboriously loaded into and out of lighters of some 8 to 20 tons capacity. These lighters were partly towed and partly rowed to the chutes, there to await their turn, or what the foreman in charge might be persuaded to consider their turn. The arguments varied, but usually took the form of a peso or two, though a box of paper collars proved most efficacious with one young man about to visit his señorita at Pisco. In very urgent cases, a bottle of the native rum (known as *pisco*, from the town where it was made), skilfully administered was pretty sure to bring immediate relief. The chutes themselves consisted of large canvas tubes about two feet in diameter, reaching from the top of the island down to just above water, and kept open by hoops at intervals of their length. The bottom end was secured to two heavy chains and anchors so arranged as to leave a triangular space beneath the lower end of the tube. The lighter was placed in this triangular space, held in position by two tackles at the stern and one at the bow, and the guano was dumped in above until the lighter was full.

The trip to the chute with an empty lighter and the morning's calm was uneventful but the return voyage was not always devoid of excitement. The breeze which sprang up in the forenoon, always from the south,

freshened in the afternoon and sometimes raised quite a little sea, and considerable backwash where the surf struck against the points of the island. In the attempt to make 10-ton lighters carry 12 tons, they were sometimes loaded pretty deeply and as progress was slow, though aided by sweeps and a sail made of sacking, the water often came over the rail, sometimes to such an extent as to sink the lighter. This was rather an expensive matter, and incidentally caused much general profanity from all concerned, including the lighter's crew, who had to be picked up, the officer in charge, who was held responsible for the loss, and the captain who had to report it to the owners.

The transference of the guano from the lighter to the vessel's hold was accomplished either by passing it up in baskets, as coal is taken on steamers at Japanese ports, or by the use of tubs which were hauled up by tackle, worked usually by man power, a laborious process, but yet one which eventually filled the ship's hold.

It was a motley assemblage of vessels that lay between the Islands waiting their turn to load. Not quite so strange, perhaps, as that gathered by Arlo Bates in "The Port of Missing Ships,"¹ but strange enough. Here was a dingy little English bark making her twenty-first voyage, and not far away the 'Intrepid,' one of the last of the clipper ship era, whose beautifully decorated cabin bore witness to the time and money bestowed upon vessels in those good old days. The 'Webster' and 'Calhoun,' lofty ships of 2,500 tons each, were once the last word

¹I am not quite sure that Arlo Bates *did* write this bit of fantasy, but if not he should feel pleased at the ascription, and apologies are duly tendered to the real author.

in Atlantic packets, and had outlived their day. At Callao we had left behind the 'Harriet Lane,' a once famous revenue cutter, now converted into a bark, that had been seized by the Confederates at the outbreak of the Civil War, and held by them throughout the struggle. A little kettle-bottomed vessel was said to date back to the time of Wolfe's expedition to Quebec, when she served as one of the fleet of transports, and from her looks one could well believe it. Rotting at anchor, converted into a store ship, was a famous English frigate whose scuppers had more than once run red with blood. As occasional visitors, we had the 'Nyack,' a gunboat in the Civil War, and the 'Kearsarge,' famous as having sunk the 'Alabama.'

It came as something of a shock to see antiquated hulks, such as usually pass their last days in the lumber trade, assigned to the arduous duty of carrying guano—one of the worst possible cargoes on account of its dead weight and inelasticity—but the explanation was even more of a shock; it was insurance and not freight that these vessels were after. As the "Guano Ring," like the "Tweed Ring," is a thing of the past, it may be pardonable to say a few words in regard to a minor part of its operations.

Every charter included a clause to the effect that a vessel proposing to carry guano should pass an examination by a Board of Surveyors to determine her fitness for the purpose or rather, to be pronounced fit, for I believe there is no record of a vessel being pronounced unfit. This Board of Surveyors, which included the Admiral of the Peruvian Navy, visited the ship when she was declared ready for survey, and proceeded to the cabin to take a little luncheon or a glass or two of wine

while the assistants sounded the pump-well and sealed up the pumps, these seals not to be broken for three days. The next step was to state that the vessel needed calking, no matter what her condition might be. In the case of the 'Lottie Warren,' which had left the graving dock only six months previously, when she was calked and newly coppered, it required an argument of only \$100.00 to convince the surveyors that they had made a mistake. When a vessel really needed calking, or when the captain chanced not to understand the rules of the game, the fee reached the sum of several hundred dollars, and in rare instances a vessel was obliged to calk merely because the fine floating dry dock could not be allowed to lie idle; it was necessary to provide some work for it, even if it was expensive for the owners.

At the time of the visit, the depth to which the vessel could load was also stated, the rule being 3 inches above water amidships for every foot of draft. Guano being a heavy cargo and every ton counting, "arrangements" were usually made to enable a vessel to load a little deeper than the legal limit.¹ In the present instance we desired to load 6 inches deeper than the depth stated, which would mean the addition of 100 tons to the cargo and \$1,600.00 to the freight. The captain was instructed to see a certain ship chandler, as the Board would leave their decision in the matter with him, and the necessary fee could be transmitted through his agency. To anticipate a little, the outcome of the matter was that when we returned to Callao to clear for London, we were in-

¹To show how ships were loaded, it may be said that the 'Lottie' of 1184 tons register, turned out by actual weight 1740 tons of guano.

formed that the ship was loaded beyond the legal limit and consequently could not sail. The captain protested to the Board of Surveyors that he had interviewed the aforesaid ship chandler and had deposited with him a fee of \$100.00 for advice. The Admiral thereupon exclaimed that the ship chandler was no gentleman, that the fee had never been transmitted and that he would sign the permit to sail and himself collect the necessary fees. This was accordingly done, and I, figuring on the books as "boy," signed the document at the customs house, stating that we would sail on a given day.

But to return to the survey. The 'Lottie Warren' had just discharged some 700 tons of ice, and water from the chips of ice and the thoroughly soaked sawdust was draining into the pump-well at the rate of 6 inches a day, so when the Board of Surveyors returned and again sought the pump-well, it was found that we had made 18 inches of water, a considerable amount for a vessel lying at anchor in ballast. However, this (to make a bad pun) cut no ice, and the necessary permit to load was signed. Various devices, by the way, were sometimes employed to take care of embarrassing leaks: the captain of one American bark, a canny Downeaster, ran a hose from the pump used for washing down decks, and for three days the crew uninterruptedly washed down decks, showing a desire for cleanliness never before nor since developed. The ship which lay next to us for a time at the Chincha Islands, hailing from and belonging to the City of London, took a turn regularly at the pumps each evening.

So much for the details of the survey. It may be noted that the Admiral perished bravely during the war between Chile and Peru, going down with his ship when

he was inveigled into chasing a Chilean man-o'-war into shallow water, where the big 'Independencia' struck a rock and was lost.

I had hoped that during our stay at the Chinchas I should add many bird skins to those collected on the voyage out, and at Valparaiso, but in this I was disappointed. Birds were surprisingly few, not merely on but about the Islands. In spite of the fact that the Chinchas had been worked for many years, that there was quite a town on the North Island and settlements of workmen on the others, one expected to see at least remnants of those vast colonies that in centuries gone by had made possible the accumulation of guano, to a depth said to be in places 150 feet.

There were many spots on the Islands that were seldom or never visited, and many outlying rocks or islets sufficiently large to support quite a colony of birds, but the birds were simply not there. The nearest approach to a colony was a small gathering of gannets on a cliff at the northwest corner of the Central Island. Dr. Murphy's recent photographs show how they have increased and spread upward onto the Island. But there were no birds occupying the tops of the Islands in 1869, none on little Blanca Islet, and none even on the Ballestas. Rosy gulls were not uncommon, and now and then we had a visit from a small flock of the graceful Inca tern. There were occasional pelicans and still more occasional giant petrels and penguins, but as a rule birds were conspicuous by their absence. In view of present conditions, it is noteworthy that I do not recall having seen a single turkey buzzard, much less a condor, during my three months' stay at the Islands.

Fishes of many kinds abounded, the most plentiful

being a small fish not unlike a white perch that appeared in densely packed schools in November. Next in abundance was a species I now know to be a carangid, but called Spanish mackerel, that was a favorite with the sea lions. Armed with a special grains, or fish spear, I spent many an hour and rowed many a mile in pursuit of these fishes, the game being to head off a school, which traveled rather slowly, and cast my grains into their midst. This was sport—now it would be hard work, for to get up at daybreak and row five or ten miles has ceased to be fun. The fact that once I took eight fish at one cast, while two or three at a time were common, shows how densely they were packed together. My best morning's work brought me 115 fish and a "blowing up" for being late with the dinghy, that particular morning being the one assigned for an early trip to the North Island.

Rock fish, two or three species of nasty blennies, an occasional trigger fish, and rarely an oplegnathid, were taken with hook and line. Larger game was not lacking. Twice a really large shark, ten or twelve feet in length, paid us a visit, and after nightfall ghostly rays could be seen gliding along in the depths, visible by the gleam of their own phosphorescence.

Interesting invertebrates were there too. Big chitons and sun stars were common on the rocks at low water, but interested me very little, since they did not provide the bait I needed. This was furnished by mussels, abundant in places, but in deep water and out of reach.

The completion of the tedious task of loading was an event deemed worthy of a celebration, according to long-established custom. For three months the work had been going on, and now the last shovelful was in, hatches

battened down, sails bent, everything ready for sailing, and everybody happy at the prospect of leaving on the morrow.

As darkness fell, the crew, reinforced from another vessel or two, assembled on the topgallant forecastle; torches and flares were lit and cheers given for the various vessels. Most of these responded in turn with cheers and lights, an occasional rocket shot up and blue lights flared, while in the forecastle many surreptitious "good lucks" were drunk to the occasion.

I said all ready for leaving, but that was a figure of speech, for really there was much to be done before a ship was actually under way. So early the next day detachments came over from other ships, and with a doubled or trebled crew the work of heaving up the three anchors and many fathoms of chain used in mooring went merrily forward, the windlass clicking an accompaniment to the tune of some favorite chanty like the "Rio Grande" or the "Banks of the Sacramento."

About noon everybody "knocked off" for dinner, and, while the crews were treated to plum duff and other accompaniments of an extra Sunday dinner, the Captain entertained his friends with the best lunch—and it was usually a good one—that the Steward could put up. In our own case, he had been saving several turkeys and two green turtles for the occasion.

Meanwhile the breeze had sprung up, and shortly after turning to the Second Mate would report, "Up and down, Sir," and half the crew scrambled aloft to loosen sails. Later on came the hoisting of top-sails, and on popular ships it was a common sight to see all three going up at once to the tune of "Whisky Johnny" and "Ranzo, Boys, Ranzo."

As the sails filled the anchor was "broken away," and with the aid of lines to the nearer vessels the ship left the berth where she had lain for three months and started for Callao, there to clear for her port of destination. It would have been a simple matter for the Peruvians to have had a custom house at the Islands, and this would have saved each vessel one or two weeks' time and from \$500.00 to \$1,000.00 in money, but the return to Callao gave opportunity for additional harbor dues, lighthouse fees, and the possible expenditure of money for supplies—items that were to be duly considered.

All this happened half a century ago. The guano industry to-day is honestly and ably administered for the benefit of the country, and not for that of a few individuals; and under the wise scheme of conservation the Chinchas are now tenanted by vast colonies of birds. Probably not a vessel of the fleet that then gathered at the Chinchas is left, and few of the sailors who manned the ships. One or two ships are said to have met the fate assigned them, and, after being carefully navigated to the latitude of Valparaiso, encountered heavy weather (in the log books), put into that port in a sinking condition, were condemned and sold, to the relief of their owners and the grief of the underwriters. One at least was burned on her next voyage, and with her went my small collection of bird skins.

As for the 'Lottie Warren,' my home for a year and a half, I know not what became of her further than that she passed into the hands of Dutch owners in 1881.

Eheu! fugaces labuntur anni (Alas, the years glide fleeting by). The good old times have passed with the fleeting years, but their memory remains and the words borrowed from Æneas and taken as the motto for my

diary—*forsan et haec olim, meminisse juvabit*—have come true—it *is* pleasant to remember these things.

Major A. J. Boyd, who visited the Chincha Islands eight years earlier than Dr. Lucas, states that they were at that time (1861) "covered with a solid layer of guano over 100 feet thick," a still impressive residue of the 13,376,100 tons which a Peruvian survey had shown to be available in 1853. North Island still had a settlement of some 3,000 people, comprising government officials, traders, soldiers and convict workmen. The price paid for guano at the islands was about \$7.25 per ton, and the freight to home ports amounted to \$10.00 per ton. Since the sale price in England, according to Boyd, ranged between \$70.00 and \$95.00 per ton, we may assume that ship-owners were by no means deprived of a living profit, despite the ingenious fees and the expenditures for sundry kinds of private connivance which Dr. Lucas has described. In 1873, twelve years after Boyd's visit, and only four after Lucas's, the guano output of the three islands had dropped to 11,634 tons, and the population of North Island had dwindled to 105 persons.

Turning back the historic pages a little farther, to the year 1853, we find a notable account of the Chinchas at the peak of the guano period in a sprightly book entitled 'Melbourne and the Chincha Islands,' by George Washington Peck, who sailed to Peru from Australia while on a jaunt around the world. Peck sent the *New York Times* the

names of one hundred and fourteen vessels which were taking cargoes during his visit. He stated, moreover, that the list was incomplete, owing to constant arrivals and departures. Let Peck review the drama of guano in the following rearranged extracts from his tale:

Oct. 2, 1853. . . . Our ship was to lie at the Middle island, and it was necessary to pass the North one and make a stretch up the bay. As we did this and came round . . . to run in for the middle anchorage several boats came off with other captains; and Cape Cod, and Connecticut, and New York, and down East generally, shook hands with Marblehead; Cape Cod, if I remember rightly, took the wheel, and New York continued to act as pilot till they ran the ship in among the others, about midway between the eastern ends of the Middle and North islands, where she let go her anchor about one o'clock.

. . .

I did not go ashore till the next morning after my arrival, when ———, whom I mentioned having met at Callao took me with him to the Middle island. The landing is under the precipice, on a ledge that makes out in front of a great cave, extending quite through the point, over which, a hundred feet above, project shears for hoisting up water and provision. On the ledge, a staircase, or rather several staircases, go up in a zigzag; . . . the lowest staircase, about twenty feet long hangs from shears at the side of the ledge, . . . and is rigged to be hoisted or lowered according to the tide, and to be drawn up every evening or whenever the Governor of the Island chooses to enjoy his dignity alone.

A few rods from the edge of the cliff, directly over the cave, is the palace of the said governor, who styles himself in all his State papers,

“KOSSUTH.”

The palace is a large flat-roofed shanty constructed of rough boards and the canes and coarse rush matting which answers generally for the commonest sort of dwellings in Peru. It has, if I remember correctly, two apartments, with a sort of portico, two or three benches, a table and grass hammock in front surrounded by a low paling, forming a little yard, where a big dog usually mounts guard. One of the apartments is probably the store-room; there is a kitchen shanty adjoining the piazza on the side most exposed to the sun. The other is the bed-chamber and dining-room of Governor Kossuth and his aids. It contains three or four cot beds, an old table and writing desk, and is decorated with a few newspapers, colored lithographs, and old German plans of the battles of Frederick the Great. Over Kossuth's couch are some cheap single barrel pistols; the floor is guano. The situation overlooks nearly all the shipping between the Middle and North islands. Directly under it, but far beneath, the cavern from before which the stairs go up runs through and opens into a narrow bight or cove, whose precipices reach up to within a few yards of the rear of the shanty. The noise of the surf comes up here in softened monotone; below are a hundred tall vessels—the North island with its strange rocks and dark arches fringed with foam—in the distance, north and east, the hazy bay of Pisco lying in the sunshine, and if it be afternoon, the snowy Andes. . . .

We went upon the edge of the cutting, where the Chinese coolies or slaves who are the only laborers here, are employed daily in cutting away the hill with pick-axes, and conveying the guano to the edge of the cliff in barrows. From the shipping the cutting appears almost perpendicular, and the slaves are just visible here and there on the side like so many insects. But from the top it is seen to slope at a convenient angle for pushing down the guano as fast as it is picked away and broken up to be loaded into the barrows at the base. There are about three hundred coolies on the middle island, and from seven to eight hundred on the north. They are kept at work by black drivers—hideous creatures who walk among them with heavy thongs; they are half naked, and their wild looks and strange cries, with the knowledge of their hard fate, makes the scene of their labor a horrid place to look down upon, both at first and ever after. . . .

The guano where exposed to the air, is of a reddish brown, yellow color, darker than that of its general substance, where it is cut away. It of course colors the whole of the islands, the rock on which it rests being only visible round the shores. As it is like light dry earth, and full of holes, it is difficult to walk upon, there being no certainty that every other footstep will not sink in nearly to the knee. If one hurries he is almost sure to fall, or rather to get into it all over, in which case the only satisfaction is in knowing that it is almost pure ammonia, and contains no animal substance, otherwise it might be thought to be an unpleasant sticky sort of soil. A few feet below the surface it becomes compact, and from thence through its whole thickness is of nearly the consistence of Castile soap. Its odor is strongly ammonical, though this is not perceived, or but faintly, in

walking over the islands where they have not been dug upon. . . .

Towards the cliff, along the lee side of each island, the surface has a steep slope; on this are placed the *mangueras*, which reach to the edge of the cliff. These *mangueras* are large enclosures made of strong canes somewhat resembling the palisade round our prisons. They are supported, as they stand on the inclined rock, by chain cables, four to each, which pass round them at different heights, and are secured above. Into them the guano is brought by wheelbarrows and dirt cars, drawn by donkeys, from the sides of the hill where it is cut away. Coolies, who are obliged to wear thick bandages over their mouths, push the guano down to the lower ends of the *mangueras*, where there are openings connected with "shutes," or long canvas pipes, about as large round as barrels, that lead down to the bases of the cliff. Through these the guano is conducted into launches, or directly into the holds of vessels loading.

. . .

When the guano is pouring down the shute into a ship's hold, she is as completely enveloped and hidden in the yellow smoke of it as if she were on fire with a cargo of lard. The ammonia is so strong that it is like entering a bottle of hartshorn to go into her interior—eyes and nose and lungs are all assailed at once. How the Cholos breathe and survive their labor as "trimmers," to distribute the guano in the hold, where it is so thick as to be almost dark, is marvelous. . . .

As we walked along the edge of the cove behind and within a few rods of Kossuth's house, we saw the coolies digging and wheeling, and their taskmasters looking on. A little back were the miserable cane huts where they

sleep, and not far from this, within a couple of rods of where they were digging, . . . we were shocked by coming upon the dead body of one lying almost naked in the sun, with the face of it covered with flies. It was one, we afterwards ascertained, who had been drowned that morning, whether accidentally or not, nobody knew—or cared. It lay among a number of little heaps or graves, and the turkey buzzards wheeled around it almost in our faces. . . .

The coolies . . . are brought here in English vessels—the fact is notorious. I have often conversed with English captains who spoke freely of having been engaged in the traffic. Whatever may be the engagement of the coolies, . . . it is characterized by fraudulent representations and bad faith in the other party; their transporters and those who transfer them to the Peruvian Government, know that *they* are engaged in a slave trade as much as if they brought slaves from Africa.

For argument sake and to smooth over the matter, they of course can urge a “contract,” “apprenticeship,” “that the coolies are as well off here as at home,” and the like; but speaking as among men of the world, all the world knows that they sell the coolies into slavery—and they cannot give it any other name that will make it smell sweeter. It is, moreover, the worst and most cruel slavery of all forms of slavery that exist among civilized nations. It was universally said to be so by captains who had visited every quarter of the globe; I am sure I never saw anything like it on the plantations. . . .

It is said that they are brought here under contracts made with them at home, to labor for five years, at a real, or York shilling, per day and their rice; and that after they have served their time out they are free to

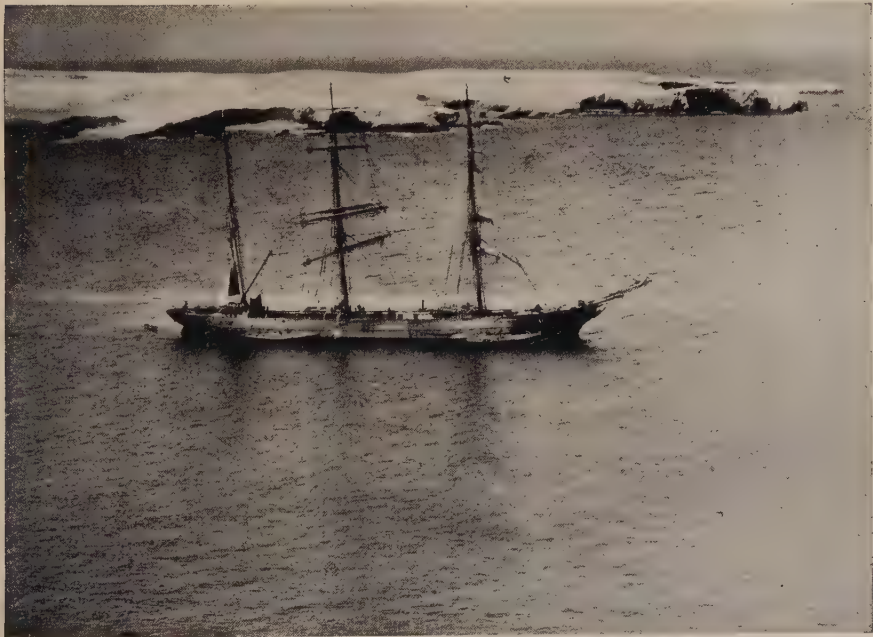
return. It is said, also, that they are induced to come by being made to believe they are going to labor in gold mines. The real truth I suppose to be, that they are contracted for by the Peruvian Government, and transferred to it at a good profit. . . . Whatever their contracts may be, if there are any, the coolies, who are one of the contracting parties become in effect absolutely slaves. They are condemned to be diggers of guano; their labor is much more severe and injurious than railroad digging; they have no liberty days, no protecting laws, no power to obtain even the pittance said to be paid them, no proper seasons of rest. Most of them go nearly naked; none have more than enough clothing just to cover themselves; they live and feed like dogs; they are constantly within reach of the thongs of hideous black drivers—the link between men and devils; there are no women among them, nothing to mitigate their hopeless toil. Before and around them is the shining bay, and beyond it green groves and mountains; near at hand hundreds of ships coming and going, filled with men like themselves, only free! They, too, have been free; they were not born in slavery; they are not domestic slaves or plantation slaves: but slaves without any title, or rights, or conceded customs—mere over-worked beasts of burden.

Almost every week some of them commit suicide by throwing themselves from the cliff. They are said to do this in the belief that their spirits will awaken in their native land. Kossuth told me that more than sixty had killed themselves in this way in the two years he has been there. One was driven over the cliff or jumped off, and was dashed to pieces to escape the lash of a black driver, who chased him to the verge in sight



NORTH CHINCHA ISLAND, WITH GUANO SHIPS, ABOUT THE MIDDLE OF THE LAST CENTURY.

From a sailor's painting in the Peabody Museum, Salem, Mass.



NORTH CHINCHA ISLAND, AND A BARK LOADING WITH GUANO, AS SEEN FROM THE CLIFF OF CENTRAL ISLAND.

of a captain of an American ship, the week before we left. The cliff where he leaped is two hundred feet high, and almost perpendicular. Kossuth affects to pity these coolies; but he is said to over-task them. Each one, strong and weak alike under his overseers, is required to dig and wheel to the mangueras, five tons of guano per day. They are kept at labor Sundays as well as other days; under Serrate, however, on the North Island, I believe Sundays are allowed them—or, at least, they are said to be paid a little extra if they choose to dig guano on that day. . . .

The coolies and their fate impart a gloomy coloring to the recollections of the whole time spent at the Chinchas. I seem to see them at their work, their slender figures quivering under the weight of loads too heavy for them to wheel; for every one who went ashore remarked that they took loads altogether disproportioned to their apparent strength, which was generally accounted for by saying "how much stronger those fellows are than they look?" But then everywhere among them are huge negroes, blacker than the ten of spades, who walk about with heavy thongs, such as they drive donkeys with, which they are laying on the naked backs of the coolies in one or another part of the diggings almost constantly. I never went ashore at the middle island without witnessing this operation, and hearing the cries of the sufferers. I observed the coolies shovelling and wheeling as if for dear life, and yet their backs were covered with great welts. The negroes did not look capable of either justice or mercy.

It is easy to distinguish coolies who have been at the island a short time from new comers. They soon become emaciated, and their faces have a wild, despairing ex-

pression. That they are worked to death is as apparent as that the hack horses in our cities are used up in the same manner.

The Chinchas, as will be inferred, rise steeply from the ocean, some of the cliffy walls standing sheer for well over a hundred feet. The only strand upon Central Island is a new and partly artificial one which fills a bight in the south strait. This is the site of the modern guano administration headquarters.

South Island, the smallest of the group, slopes down to a beach on the southeasterly or windward side, but the shore is here extremely rocky and is pounded by a surf which never ceases, not even when the Bay of Pisco seems calm. On the off-shore exposure, as Peck remarks, "the ocean is forever heaving and receding with a slow mighty motion, as if it were the breathing of the world. Here the rocks are whiter and the cliffs higher and more weather-worn. I know not if it is ever so calm on this side that the caves which may be seen to extend in hundreds of feet, can be ventured into with safety. The set of the great ocean waves, is so irresistible, that if a boat should once be caught by it in a narrow passage, where the whole water moves with the heave, she would be swamped in a moment. An English captain was said to have gone in his boat into one of the largest of the leeward caves, and was never seen or heard of again." A mysterious wave phenomenon is often observable

on still mornings when, although the surface is unruffled, the waves pile up on the beaches and dash to yard-arm heights against the precipices. These are the "surf-days" for which special allowance was formerly made in the charter agreements of vessels loading at the islands.

North Island has several short stretches of yellow beach upon which boats may usually be run ashore. In general, however, it is the most rugged and irregular islet of the three, and access to the house of the resident guardians is to be gained only by means of a rope ladder hanging over the water from a suspension dock. The former borders of all the islands have been eaten away by the sea, leaving relics in the form of pyramids or clusters of emaciated rocks which make an uninterrupted fringe of outliers. The buttresses of the present cliffs have also been worn into grotesque shapes, and the islands pierced by extensive caves in the domes of which the rising swells compress the air like pistons, and are spewed out again with an explosive surge. As a rule, granitic rock does not lend itself readily to the formation of caves and archways, but at the Peruvian islands the basal grinding by wave-borne waste has undermined the cliffs and has caused sections of the rock to collapse along the joint-planes. The resulting orifices are at first squarish, like quarry trenches, but subsequently they become rounded by further wave battering and by disintegration due to changes in

temperature. Part of the five-fathom strait between the Central and South Chincha Islands, which is at present but two cables in width, was perhaps at one time the belly of a vast cave into which the roof or sea-arch fell to make two islands out of one.

On top of the rock foundations of the Chinchas are deposits of water-worn pebbles which give a clue to the geological history of the islands. The sediment was probably laid down during the latter part of the Age of Mammals, when the rivers on the western slope of the Andes were of greater volume than to-day. With the uplift of the Peruvian coast, which occurred, judging by the testimony of marine fossils, during or close to the northern Ice Age, the Chinchas and the neighboring Ballestas Islands appeared as peaks of the irregularly raised granite crust, but covered with the gravels and silt of the former sea bottom.

With this upraising of the coast, however, and the consequent slackening of the supply of stream-carried material, the sea commenced the process of gnawing down the islands and the new coastal shelf. The rollers, driven forward by all but invariable southerly winds, combined with the sharp temperature changes of night and day to hasten the dissection of the sea-born land, until now, in the bay of Pisco, only the straight-walled plateaus of the Chinchas, the Ballestas, and a few isolated rocks remain.

Central Island is the highest of the group, its peak having to-day an altitude of 261 feet, to which another hundred feet may have been added by the former blanket of guano. As a lookout, the summit presents a panorama so beautiful that an observer must be stolid indeed if he can resist a feeling of exultation when he beholds it. The two sister isles, especially the lower and more distant North Island, round which a hundred square-riggers used to rock their spars, seem to lie at one's feet like white stars in the blue field of the sea. The western half of the circle of vision is taken up with the ever-varying Pacific, often covered with netted foam-streaks, and by the pre-vailingly cloud-filled sky in which feather-wisps and mare's-tails form all summer above the Humboldt Current. The off-shore layers of cloud usually hang low in the west to hide the sun just before it nears the horizon and blazes forth again at the end of day. On this side, too, beyond South Island, stand the picturesque twin cones known as La Goleta (The Schooner). To the northeastward one looks toward Tambo de Mora, the Pampas de Ñoco, and the crests of the cordillera, beyond which still higher crests, of a thinner and colder blue, reveal themselves on the clearest days. In the southeastern quarter lies the bay of Pisco; the mountain-in-the-sea of San Gallan, with its westerly peak always hidden under a mantilla of fog; the Ballestas and Isla Blanca; the red hills of

Paracas Peninsula, which all but conceal the deep cove behind them; and the desert south of Pisco, blocked at the southern end by coal-bearing ridges, but stretching inland toward the vine-growing country of the Ica Valley. When the weather is calmest and brightest, the great Indian symbol of the *Tres Cruces*, which is carved on the seaward mountain slope, can be seen with the naked eye from Central Island, although its distance is 11 sea miles. Heightening the charm of land and ocean and atmosphere, is the fact that the circumambient whole vibrates eternally with life. The bay of Pisco is dotted with ruffled or shimmering areas where schools of anchovies or herrings are moving near the surface, the myriads of individual fishes straining out with their gill-rakers the invisible plant life which thickens the water; birds and seals in turn pursue the massing fishes, and oftentimes one can watch from the hilltop small groups of humpback whales which breach and blow, and then point up their flukes for the "long dive." Finally, the white hillsides about one are likely to be darkened by vast, huddled crowds of guanayes, while waving lashes of the same birds are silhouetted against the sky in all directions.

The Chinchas are, of course, absolutely devoid of vegetation above high-water mark. The native animals, in addition to birds and sea-lions, include parasitic ticks, pale yellow scorpions, ground-spiders which riddle the soil and guano with their

silk-lined tunnels, Mallophaga or bird-lice, carrion beetles, several kinds of flies, and lizards of the genus *Tropidurus*. The latter live in part in burrows made by the Inca terns, and occur not only on the flat ground but also all over the sheer faces of the cliffs.

The day after reaching the Chinchas I began field work by crossing the strait from the guano administration dock, and climbing the flimsy stairway to the flat top of South Island. A young Indian called Pizarro (an ironical name for a descendant of the Incas!) was assigned to carry my camera and bring back the natural history spoils. We found that the breeding grounds of the guanayes had here just one year's accumulation of guano, and that most of the birds were about to begin a new nesting season, so after brief reconnoitering we returned.

On a gray, calm morning a few days later, I made my first visit to North Island, historically the most important of the three Chinchas. Señor Andres Gaggero, of the guano administration, and an Indian sharpshooter named Melitón Lurquin, who was subsequently my capable assistant for many weeks, escorted me. A boatman backed a flat-bottomed skiff through the surf to the edge of a shingly beach below a cliff on the north side of Central Island, and I confess that I was much concerned for the safety of the outfit, especially the Graflex camera, while the three of us were em-

barking, and until we had finally hauled out beyond the breakers. The skiff was a clumsy little craft, too small for four men, but it served rather precariously until we could borrow a life-boat and two oarsmen from the schooner 'Ballestas,' which lay at anchor in the north strait.

Even with the more seaworthy boat we had difficulty in landing on North Island, where the eroded coast seemed to be a succession of little promontories, rock-bound coves, and black caverns into which one could see by light reflected from the swirling foam below. Spires, tunnels, arches, and all manner of embattlements decorated the huge granite blocks that had separated from the main island, and each of these islets was gleaming with nesting piqueros. While we were leaping ashore from the bouncing boat, lobos were feeding and roaring close by, a pair of penguins were making love on an adjacent rock, and black oystercatchers were standing on the tips of neighboring points and watching us with startling, saffron-yellow eyes.

Ashore on North Island we found pelicans to the number of several hundred, and an extraordinary number of vultures, and gulls. Lurquin immediately began his duty of slaughtering as many as possible of the two latter species, both of which are serious enemies of the guano-producing birds. The guano administration maintains sharpshooters at many of the islands for the express purpose of

killing off these pests, and I was informed that during February and March of 1917 more than five thousand of the predaceous gulls had been shot on the southern islands, between Pachacamac and Santa Rosa. They are still extremely abundant, nevertheless. Lurquin adopted the cruel but effective expedient of attaching wounded birds to a heavy bag of sand, so that their struggles and cries would lure other victims within range. I examined a large number of stomachs of the gulls and found that most of them held damning evidence in the form of remains of young guanayes and piqueros. Several also contained fish which the gulls may have captured themselves.

The western border of North Island passed all power of description for savage and chaotic beauty. It was a region in which rock and ocean and sky were intimately mingled, and the ensemble was filled with tens of thousands of white piqueros, slaty Inca terns, and other exquisite birds. From the edge of one part of the cliff we looked down into a cove, the water of which was transparent to the bottom. A natural breakwater of jagged rocks kept it relatively free from the swell and at the same time made it inaccessible to boats. The surrounding cliffs sheltered it from the wind, and offered no pathway of descent that any beast except a lizard might have used. The virgin beach below was occupied by a lone and sleepy penguin, and the slope at the foot of the cliff was black with basking Inca

terns. Half way toward the crest of the precipice a niche extended all the way around the horse-shoe curve, and this, the box-tier of a splendid amphitheatre, was crowded with piqueros at their nests. In the center of the cove was the actor—a baby sea-lion chasing his tail. Around and around this aquatic buffoon whirled, first to the right, then to the left, and whenever he came to the surface, a cloud of hovering terns would concentrate about the spot of broken water.

Although the sun only filtered through the clouds during the whole hazy morning, the forenoon light reflected from the white guano seemed more dazzling than that from snow. Doubtless the nitrogenous particles which blew into our eyes aggravated the blinding discomfort. In the most glaring, dustiest, hottest, and ugliest part of the island, we came suddenly upon the place which the courteous Spanish tongue dignifies by the name of *panteón*. From the sides of dismal gulches, human hands and feet were protruding; here and there, completely exhumed, lay heads partly covered with hair. Farther up the slope, apart from the others, a woman and child, wrapped in coarse textiles that were still well preserved, reposed side by side, half within the ground and half out. Other corpses included some which, I fancied, looked like mongolians, lying with their mouths wide open as though they were yelling at the heavens. Everywhere were toes pointing skyward, even when no



PRECARIOUS NESTS OF THE PIQUERO, CHINCHA ISLANDS.
The upper scene shows also a guanay and two Inca terns.

other part of the bodies showed. All of these remains dated from the early days of riotous guano traffic, when many of the poor coolies, despairing of ever returning to their native Macao, dashed themselves over the cliffs, while others found a temporary resting place in the guano; but after each period of extraction the birds once again perch upon their skulls.

On the eastern side of North Island we sighted the picturesque wreck of the British ship 'Leonidas' which had lain a short distance off shore for many years. Only the bow and the masts with their spars were above the surface, and these were covered with birds. Not far from the hulk was the dwelling of the guano watchmen. From the hanging dock in front of the house we descended a rope ladder to a boat, and were rowed back to Central Island.

CHAPTER VI

ANCIENT PEOPLE OF THE COAST

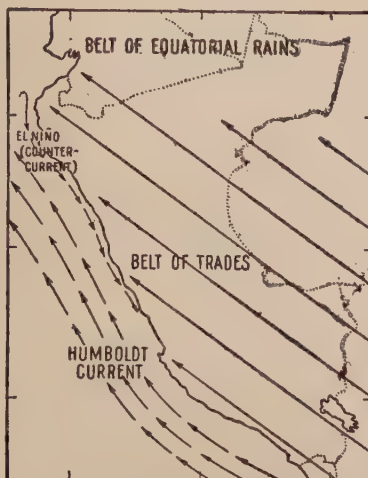
AFTER a few days at the Chincha Islands, I made a trip in the launch 'Mazorca' to a place known as the Puntilla, at the entrance of Paracas Bay. On this part of the mainland coast there are excellent wells, from which the drinking water used upon the guano islands in Pisco Bay comes now, as no doubt it did in prehistoric times. The guano administration maintains a pump, pipe-line, and house at the Puntilla, all under charge, at the date of my visit, of an extremely talkative keeper named Tomás Polo. There is no other habitation within several miles.

We put forth from the Chinchas early on October 19, 1919, a fair, sunny morning, with a south wind of usual morning strength, namely, about 2 of the Beaufort scale which is used by navigators, or what would be called a "light breeze." A very few feathery clouds speckled the sky overhead, with top-heavy cumulus formations hanging over the land well back from shore. I refer to such precise

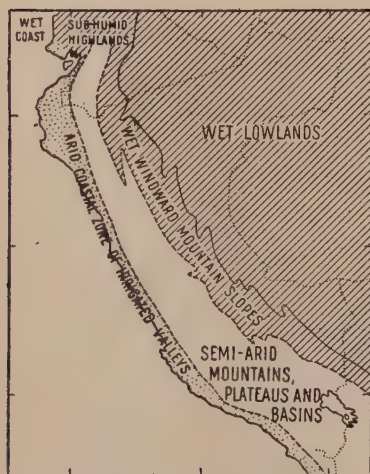
ANCIENT PEOPLE OF THE COAST 127



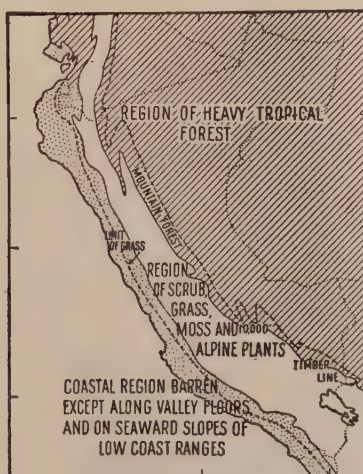
The three chief topographic regions of Peru



The wind belts of Peru and ocean currents of adjacent waters



The climatic belts of Peru



Belts of vegetation in Peru

From Bowman's "The Andes of Southern Peru." Reproduced by courtesy of The American Geographical Society

meteorological facts not by way of passing description, but because they are typical of the beginning of each day in the Humboldt Current during the season of the southern summer. Among the fishermen of Pisco and San Andrés, the dependable southerly wind is termed the *paraca*, after the peninsula from whence it sweeps across the bay. It commences in early morning, or sometimes not until the forenoon, blowing gently, and proceeding from a direction somewhat west of south. Increasing through the middle of the day to a normal maximum of 3 or 4 of the Beaufort scale, so that it covers the ocean with whitecaps, it also swings through south to the eastward, thus "following the sun" in a manner characteristic of steady, coast-wise air currents. In mid-afternoon (the exact hour is variable), it blows at its highest velocity from somewhere east of south, more strongly close to the coast than off shore; but before sunset it ends rather abruptly and leaves a vesperal calm.

The journey southeastward to the mainland gave us good views of the Ballestas Islands, San Gallan, the Tres Marias, Isla Blanca, and the northern part of Paracas Peninsula with its lofty headlands. Two miles west of the mouth of Paracas Bay, we turned inshore to inspect the remarkable Indian beacon known as the Tres Cruces, which is carved on the brick-red slope of the hill. Various religious traditions have become associated with this symbol, but it certainly has no relation with the Christian

cross, being an aboriginal monument dating probably from before the Conquest. Its lines are deep trenches in the soil, and it appears to be several hundred feet in height. Like a giant candelabra it rears its arms serenely above the sandy, alkaline terraces in which tens of thousands of the ancient inhabitants of the coast lie sleeping.

Midway in our passage of Paracas Bay, we could look far into the sheltered seclusion of Seguíón Cove to the southward, a harbor which impressed me as the best site for a fishing station that I had yet seen in Peru. The coast towards which we were heading was low, sandy, and hot, with bare hills in the distant background. It reminded me strongly of the Cape Verde Islands, and later I was struck by the curious coincidence that the first two creatures that I had collected, both upon those African islands and at the Puntilla, were a species of curlew and a species of gecko.

The only visible vegetation on shore near the Puntilla was a clump or two of palms, and a hedge of rank, succulent glasswort just behind the strand. A water pipe extending from the well to the anchorage of the tank-boats was being used as a roost by a long line of the black cormorants known as *cuervos de mar* (sea-crows). In front of the guano administration cottage was a shallow tidal lagoon in which schools of mullets were jumping, and about which dense flocks of shorebirds were feed-

ing. The latter were mostly migrants from North America, and included such familiar acquaintances as sanderlings, semipalmated and spotted sandpipers, and ringneck plovers. Nor were these the only northern travelers in the neighborhood, for our own familiar barn swallows were darting back and forth along the beach, and three ospreys were circling high above the bay. In the desert, back from the water, the sole visible beings were the omnipresent vultures.

Tomás Polo, the garrulous keeper, prepared us a good breakfast. When he saw me skimming minute sugar-ants from the surface of my tea, he assured me with an air of remonstrance that ants are good for the stomach. He maintained the hospitality of the guano administration at this station, but he and his wife and children, and eleven dogs, lived in their own aggregation of small reed huts about fifty yards from the house. The cooking was done by the wife at the huts, and Tomás would dash at top speed from there to the dining table whenever we were ready for a new course. A huge, steaming dish in each hand put no check upon his velocity.

After breakfast we started along shore with Tomás toward the ancient cemeteries. Although he was bare-foot, he seemed very shy about wading ankledeep into the bay for a plover that I had shot from the beach. This was at first incomprehensible to me, but he presently explained his timidity by



BLACK CORMORANTS OR CUERVOS ON THE GUANO ADMINISTRATION WATER PIPE
AT PARACAS BAY.



THE CANDELABRA OF THE TRES CRUCES, PARACAS PENINSULA.

showing me where a stingray had driven its spine an inch and a half between the bones of his instep. The excruciating experience had occurred in the shallow, sun-warmed waters of this same beach about three months before, and the wound had not yet fully healed. On another occasion, nevertheless, I was a witness that Polo did not hesitate to wade after a *pulpo* or octopus, which he turned inside out, disemboweled, beat and trampled, scrubbed with sand, washed in salt water, and then took to his out-door kitchen to be cooked.

Many wild dog tracks wound across the sandy stretches behind Paracas Bay, and later Polo gave me the jackal-like skin of one of these mammals, which the Peruvians call *zorras* (foxes). The only other quadruped encountered during our walk was a gecko which I captured, but which subsequently escaped, leaving its tail behind it. Polo and his companions, all native Indians who had doubtless known geckos from earliest childhood, were horrified at seeing me handle the harmless little reptile, for, in Peru as elsewhere throughout the world, lizards of this particular group are held to be diabolically venomous. Their large and spookish eyes, apparently, are the features which condemn them, and, at any rate, Polo began to prattle the same tales about the tiny creature that natives of the Lesser Antilles had told me years before about the dreaded "wood-slaves" of a related genus. I asked Polo whether he had ever known of anyone

being bitten by a gecko, at the same time holding the lively little lizard so that its snout pressed against my cheek. Polo was almost too enthralled at watching me flirt with death to answer, but finally he said that he knew a man who had been bitten on the knee by one, down by Independencia Bay, and that his leg had swelled this big (indicating the circumference of a keg). Then, with irrefutable logic, he sought to establish the truth of his assertion.

"Did you see the swelling, Polo?" I asked.

"No, señor, but I heard all about it, truthfully."

"Did you ever see the man who was bitten?"

"No, señor, but many of my friends saw the man."

"How do you know that it was this kind of lizard that bit the man?"

"Because, señor, this is the kind of lizard that makes that kind of bite!"

But while Polo's fear had been mingled with interest at seeing me play with the gecko, he showed only unqualified terror, and quickly put fifty yards between himself and me, when I picked up a fine snake, which lay in kinks upon the sand near the edge of a cluster of palms. I dropped the snake into a bag, tied up the top, and made Polo carry it, while one of the hardened Indians from the Chinchas explained to him that this Americano knows about everything—birds, lizards, fish, ticks, scorpions, and bugs—and that if he tells you the

culebra won't bite, it won't. Polo may have been convinced that the snake wouldn't bite *me*, but his faith went no further.

Along the southern third of the Peruvian sea-coast the maritime ranges rise almost directly from the edge of the ocean. But beginning in the vicinity of Paracas Bay, flat or rolling wastes, which increase in breadth as one goes northward, lie in many places between the strand and the mountains. In most of central Peru the coastal agricultural lands are close to the seashore, occupying practically the whole of the valley-deltas between stretches of the desert. In the north, however, the zone of cultivation is pushed back from the sea, so that at Pacasmayo and Eten, for instance, wide arid pampas separate the ocean and the tilled fields.

The latter condition is foreshadowed to a certain extent just south of Pisco, the parched country adjacent to Paracas Bay being very different from the green plains of most of the coastal valleys, such as that of the Rimac at Callao. The Rimac and Pisco rivers approximate one another in volume, but verdure in the Pisco valley is to be found chiefly at some distance upstream. The lower parts of the pampa behind the strand which extends from Pisco clear around to Paracas Peninsula have evidently been beneath the sea in the not distant past, for I found them thickly strewn not only with shells of marine mollusks, but also with bones of whales and porpoises, the latter in some cases far back from

the present water line. North of the Puntilla, which marks the entrance of the bay, the beach itself is composed wholly of large waterworn stones, and is raised high, like a dike, with a steep sea-face. Beginning abruptly at the Puntilla, a broad stretch of fine-grained sand extends southward around the head of Paracas Bay. Such beaches are characteristic of the windward margins of landlocked Peruvian bays, as distinguished from open coasts swept by sea winds. On the higher parts of the Paracas pampa, farther back from the bay, the surface is a mosaic of marine and æolian *débris* through which ridges of alkaline salt project in funguslike masses. The ground is so filled, moreover, with cavernous formations of this salt, that in many places it rings with a hollow sound when stamped upon. There seems to be also considerable gypsum, for the extraction of which many holes have recently been dug. Here and there one finds excavations of such depth that they expose the layer of rounded pebbles, cemented into a fragile conglomerate, upon which lie the more recent deposits of the upraised coastal shelf.

Inland, the mesa drops sharply to the outer border of the Pisco valley, where there is some sparse vegetation in the way of grasses and palms, and where herds of feral, runaway burros were grazing in complete seclusion at the date of my visit. In the olden time, cultivation of this part of the valley was probably more extensive than to-

day, for the ruins of several large, abandoned dwellings are half hidden here among clumps of palms. One such, which may once have been the homestead of a great *hacienda*, I entered. It had a spacious and beautifully patterned floor of baked bricks in a perfect state of preservation, but its thick adobe walls had all but crumbled away, and now served only as the rear support of two deserted reed huts of the Indians. The huts contained nothing but a rag doll, a broken wine jar, and two whale vertebræ by way of stools. Beside the old building was a well of greenish water, and, not far off, five sunken, rectangular meadows, each surrounded by a high embankment. The leveled ground within them was moist and grassy, and in each enclosure some fig trees were growing. The whole silent ruin, devoid of life save for a few sunning lizards, hidden by barren sand hills from both the shore and the irrigated country, might have passed for a lost Saharan oasis.

They say the Lion and the Lizard keep
The Courts where Jamshyd gloried and drank deep;
And Bahrá'm, that great Hunter—the Wild Ass
Stamps o'er his Head, but cannot break his Sleep.

But, antedating such settlements of colonial Spaniards by nobody knows how many centuries, are the beacons and graveyards of the ancient people of the coast, the same, no doubt, who ex-

tracted guano from the Chinchas when western Europe was still a wilderness. The ubiquity of human remains in the soil of coastal Peru might give the impression that, for ages past, teeming populations had made this desert their home; but the true significance of the multitudinous dead is rather that decomposition has been so inhibited by the climate that the buried corpse endures as a witness long after all trace of it would have been obliterated in less arid regions of the earth. On coastal terraces below the Tres Cruces, and, south of the Puntilla, among sandy wastes which were once part of the shallow bottom of Paracas Bay, still undesecrated cemeteries of the indigenous people are distributed far and wide.

After breakfast of October 19, 1919, as stated above, I started off, with Tomás Polo and several Indian boatmen from the Chinchas, toward the *panteones*. We turned inland from the beach of the bay, and walked for two miles, over bare, coarse, scorching sands, in the direction of the unworked Paracas coal fields. We first visited some burial grounds which had been partially rifled of their treasures, and afterwards several which had never been disturbed. Among the former, there were still many objects of beauty or interest lying at the surface, or half buried; doubtless more notable *huacos* were hidden with the corpses in unopened graves. The methods of the professional grave-robbers were described and demonstrated to

me, one of the Indians, in fact, going through all the processes in merry pantomime. The huaco hunters carry a long, pointed, iron rod, which they thrust into the yielding sand to probe the graves. Experience gives them great powers of discrimination with this attenuated finger. If they prod nothing which feels like metal, or pottery, or fine textiles, they mutter "*pobre*" (poor) in a disgusted tone, and move on to another grave which may prove to be "*mas rico*" (richer). Digging out the bodies and their accoutrements is a laborious task, for the sand flows almost like fluid, and one must begin with a wide trench at the top in order to have even a narrow one four feet below.

Many of the cadavers had been unearthed, and were lying about in the burial posture with the knees drawn up against their chests. The brown skin had shrunken against their bones, and they were so light from age-long desiccation that even the largest of the men could easily be held at arm's length in one hand. The hair on their heads was very long, but not always black, for in some instances it had bleached to a pale reddish. The textiles enclosing the bodies ranged from well woven white cotton cloth to woolen strips with elaborate designs in three or more colors. Black bands, of very fine weave, had been wound around the heads of many. Pottery vessels containing meal or beads were clasped in some of the shriveled arms. I have no knowledge of Peruvian archæ-

ology, and I can judge only from the absence of any Christian symbol in the Paracas graves that these dead must have belonged to a period preceding the Conquest; yet the climate and the alkaline soil had not only embalmed their bodies, but had even kept unchanged the corn in their bowls! There seemed to be a large proportion of children and infants among the dead Indians. Besides the body of one little tot who had a bushy crop of shiny black hair, like that on a Japanese doll, I found the mummy of a cavy or guinea pig. Doubtless the little beast had been especially prepared as a funeral object, for its hinder parts were sewn up in cloth.

Numerous corpses had been broken up by the process of disinterment, or during subsequent exposure. I noted particularly the magnificent teeth in their jaws, including the fully developed third molars or wisdom teeth, which are usually so abortive among modern civilized men. In numerous instances the teeth had been greatly worn down by mastication but were, nevertheless, sound throughout. Only four skulls, among perhaps fifty examined, showed evidences of dental decay, the defective teeth in three of these being one or more of the grinders in the lower jaw; the fourth case was the mandible of a very aged individual who had lost all of his or her lower teeth some time before death. A curious and unique skull was one which had been artificially and intentionally dis-

torted during the youth of its possessor. Hair and skin still covered this, but the back of the cranium had been bound in such manner that it had grown out into a long cylindrical turret, with the crown of the head on its flattened summit.

I brought away from the Paracas cemeteries a miscellaneous assortment of trinkets, comprising the following: a tattooed forearm; pottery vases and bowls of various attractive shapes, including several with decorative designs in black, red, and green; a gourd bowl of exactly the same sort as that from which the modern *cholo* eats his rice; bone and wooden needles, and bundles of spindles made from wood or thorns; needle cases of bamboo; staves or canes, each with a human or animal figure carved upon its upper end; a fiber net containing skeins of woolen yarn of red and golden yellow hues; many pieces of cotton cloth, some white, and some with a brown, plaidlike pattern; bits of three-ply fiber rope; tufts of flamingo feathers still bright with the dawnlike flush that they may have had five centuries before; several exquisitely woven slings, fit for the skill of a David; a fragment of woolen tapestry (as I should call it) bearing the grotesque, colorful, and much dressed-up figure of a man; a woven bag of pleasing design; and a packet of mixed beads made from shells, earthenware, and the ivorylike limb bones of birds. All of the staves that I saw were discolored in the middle, where they had also nearly or quite rotted through. My Indian

companions said that a staff was usually found lying across the corpses of the ancient men, and that the part in contact with the body was invariably decayed, while the extremities of the wood were sound. Projecting here and there from the sand in the burial grounds were red earthenware jars as large as barrels, but the problem of transportation was too serious for me to consider appropriating one of these.

In Peru one never leaves the domains of the dead, and the antique burial grounds that I have briefly described are but examples of myriads that lie between the Pacific and the high cordilleran valleys. At Huarmey I have seen hillsides with human bones and relics fairly oozing out of them. Many coastal necropolises, such as those near Trujillo, Ancon, Pachacamac, etc., were famous structural monuments, with great sepulchres, passageways, and temples, built by master architects and masons—vastly more notable and pretentious resting places than those of the simple fisher folk or guano diggers of Paracas Bay. The loot from such pre-Columbian tombs has been inconceivably great, so that to-day, with innumerable graves still undiscovered or unexploited, the homes of the present inhabitants of the country and the museums of the entire world possess in the aggregate hundreds of thousands of ancient Peruvian relics. I had opportunities of seeing in Peru several private collections rich in objects of beauty and intrinsic worth.

One which was the property of the late Dr. Javier Prado y Ugarteche, rector of the University of Lima, is so noteworthy that it may be of interest to record my memories of it.

Shortly after arriving in Lima I had the pleasure of calling upon Dr. Prado, and of being conducted through the museum which occupies a large wing of his luxurious home. Room after room was filled with Incaic and other aboriginal articles—pottery, textiles, cast and beaten metal, gems, utensils, and ornaments of many descriptions. The installation was no less attractive than the material exhibited. All of the rooms were softly illuminated, and the shelves upon which the pottery stood were of dark native wood, built and carved by Peruvian workmen. These shelves were all open, so that the jars and images might be handled freely, and were divided into small compartments, each holding about three pieces. Above the shelves, in some of the rooms at least, the walls were of a rich crimson, which, with the ancient-looking beams above, the raw wood of the carved cabinets, and the dim light from the patio, imparted an indescribably charming and sumptuous air. The pottery was by no means all of one type; some of that from the extreme north of Peru had a totally different aspect from the rest. The colors and designs seemed innumerable. As I glanced at several thousand objects, it was impossible to carry away a very well organized impression. I recall many strikingly Egyptianesque

figures, seated, perhaps, in the rigid pose of the Pharaohs. Others looked as though they represented negroid peoples, for although they were said to antedate the Columbian era by centuries, the clay faces had black skin, and exaggerated red lips such as negro minstrels paint around their mouths. Among the animal portrayals, which were particularly fascinating, I recognized owls, jaguars, serpents, armadillos, anteaters, llamas, porpoises, rays and other fishes, dogs, parrots, pelicans, and many more. Some of them were glazed, and seemed like prototypes of the modern Copenhagen porcelain, but far more imaginative and powerful, besides which, these were all objects of utility, the æsthetic qualities of which were a by-product. Two pitcherlike representations of human heads especially stick in my memory; one of an Indian chewing coca, with a characteristically screwed-up mouth, the other a rough, amorphous piece which bore an extraordinary resemblance to, or at least strongly suggested, Rodin's head of Balzac. May not this have been the creation of some independent, "ultra-modern" craftsman of the days before Atahualpa?

If Dr. Prado's pottery was interesting, the textiles from the looms of a people who were the finest weavers of all time were even more so. There were many fragile and exquisite scraps behind glass upon the walls, and larger pieces in cases which harmonized with the whole setting. Garments as



A WOVEN BAG IN BLACK, GOLD, AND BLOOD-RED, FROM AN ANCIENT GRAVE AT PARACAS
BAY.

well as fragments were well represented, the former ranging from a baby's poncho, covered with spangles in the form of tiny silver fishes, to a magnificent green robe into which were woven figures and stories of gods and men, the whole worthy of interpretation not by a mere archæologist but rather by the immortal panegyrist of a Grecian Urn.

A mummy of a noble Inca, which had never yet been opened, was clad in a tunic covered with hieroglyphics, and around the neck hung a string of beads cut from chrysoprase, a mineral which the white invaders have never found native in South America.

Among the hundreds of smaller objects that were shown me by my host, I remember at random the following: pipes of Pan quite like those of Greece, other wind instruments made of metal or bones, apparatus for spinning and weaving, Incaic weight balances with the gold still in their nets, and golden vessels and breastplates with pressed or beaten designs in low relief.

CHAPTER VII

INDEPENDENCIA BAY

IN middle November it became possible for me to make a long anticipated trip to Independencia Bay, beyond 14° south latitude. Before dawn of November 15, the trawler 'Alcatraz' arrived at the Chinchas from Callao with orders from Señor Ballen that it be placed at my disposal. When I awoke in the morning, I had the cheerful surprise of finding a large packet of letters from the United States and Lima beside my bed.

Captain Ponciano Mendeguren, a deep-sea navigator of Magellan's race, in other words a Basque, and a citizen of Spain, was temporary master of the 'Alcatraz' during the illness of Captain Tassi. We got under weigh in late forenoon, a bright morning with a fresh breeze. Heavy condensation over San Gallan Island presaged more violent weather to the southward. The fog which almost always overhangs the crowns of San Lorenzo, San Gallan, and Isla Vieja is due, as previously noted, to the cooling of moist sea wind when it is

forced to rise rapidly and flow over the headlands. The vapor is condensed before the moving air comes into actual contact with the peaks, so that the pennons of fog stretch forth in an apparently anomalous manner, namely, directly *into the wind*. The stiffer the breeze, the longer are these windward weathercocks. The water particles, traveling with the speed of the whole column of moving air, are reëvaporated as soon as they pass beyond the summits, so that no leeward streamer forms; but in times of high wind cloud-scrapes are sometimes torn away bodily, and whisked off a considerable distance before they are melted by the warm atmosphere of the low strata. The cloud-caps of the peaks are, through continuous condensation and resolution, made up of entirely new bodies of moisture every few moments, but since the form remains the same, they have the appearance of being fixed and motionless. At times when even the high clouds are rapidly crossing the sky, it is curious to note the stationary streamer of San Gallan, which varies only in ratio to the strength of the breeze, and which vanishes only during periods of calm.

The 'Alcatraz' passed within a stone's throw of the Ballestas Islands, of which I had my first view at close range. They seemed to be weathered away and undermined to an even greater extent than the Chinchas, with many deep, black caves and long-span arches. These islands are, perhaps, the most beautiful of the whole Peruvian coast.

Standing on the crest of the highest in 1854, and gazing down at a hidden cove two hundred feet below, George Washington Peck recorded his emotions in the following words:

It gave to me the feeling of sea views in the ancient poets, in Spenser, the Tempest, the landscapes and backgrounds of the old masters, and not least, though last in the sea music of Mendelssohn. I think if one could land within that open arch at the time of the full moon, and should see no mermaids or nymphs of the ocean there, he ought to be convinced that there are no such beings in the world.

Between the Ballestas and the strait or *boqueron* which separates beetling San Gallan from Paracas Peninsula, the wind blew with increasing strength, thus fulfilling the prophecy of the elongated cloud-cap. In the middle of this high-walled, forbidding passage, which is known as the Boqueron de Pisco, I hauled a silk tow-net for five minutes at the surface, while the 'Alcatraz' ran at quarter speed. The catch proved very slight, but on subsequent occasions I collected in these same waters great quantities of plankton, including algæ, eggs of fishes, copepods, and crabs in the larval stage. A strong current was flowing northward through the strait, where the temperature of the surface water was, moreover, much lower than that in the Bay of Pisco whence we had come. Near the windward entrance of the boqueron, diving petrels began to

be common, and thereafter we saw many of them, mostly in groups of ten or twelve, in the rough sea all the way to Independencia Bay. They struggled to windward at the approach of the steamer, or made frantic little dives, without going far below; none covered a distance of more than twenty feet before reappearing. It was in exactly this locality, within sight of San Gallan, that the French naturalist Garnot discovered this extraordinary bird during the cruise of the 'Coquille' in 1823. The Peruvian diving petrel, like so many other animals of the coast, is a creature of antarctic affinities; no other species of its family is found north of 37° south latitude, or thereabouts, but the Humboldt Current is responsible for the extension of its range northward to Lobos de Tierra.

About four o'clock in the afternoon we passed Mount Carretas, just north of our objective, the little 'Alcatraz' pitching and covering us with spray as she nosed into the rolling seas. When we finally turned into Trujillana Channel, the northern entrance of Independencia Bay, smoky clouds, ripped from the concealed promontory of Isla Vieja, were scudding low across our deck, and the bobbing 'Alcatraz' was completely drenched with torn-up water. Out at sea, the day wind had already died down, and we could see, far off shore, the line of calm; but inside Isla Vieja the gale seemed to be constantly increasing. Large flocks of petrels, in-

cluding sooty shearwaters, fulmars, Cape pigeons, and Mother Carey's chickens, were playing in the gale close to the north point of the island, and herds of sea lions which numbered hundreds of individuals hurried past us in the white-capped water. Sooty shearwaters, or *doñas* (ladies), were of all the birds the most abundant; there were certainly upwards of ten thousand in one dense flock off Dardo Head, of Isla Vieja, the long-winged graceful petrels flying high and low in the howling wind over the choppiest areas of water. Do the petrels seek such whipped-up places because the wind and waves bring their food to the surface? Whatever the reason, they were marvelously at home in the terrific gusts, while small groups of guanayes, resting upon the water in our course, hesitated long before even attempting to rise against the raging wind.

When the 'Alcatraz' had steamed far into the southern part of Independencia Bay, toward the windward entrance, which is known as Serrate Channel after the admiral who perished here during the War of the Pacific, the breeze abated considerably. We dropped anchor in twelve fathoms, not far from the southeastern corner of Santa Rosita Island. At dusk, we could see lines of penguins standing along narrow beaches beneath the cliffs. After a supper served on deck, I retired to a canvas room which had been especially erected for me in the stern of the 'Alcatraz,' and through the night a



GUANAYES LANDING IN THE COLONY AT PESCADORES ISLAND.



GUANAYES TAKING FLIGHT. SANTA ROSA ISLAND, INDEPENDENCIA BAY.

distant chorus of agonized wailings and demoniacal yells was borne to my ears from herds of sea lions on the rocks of the offshore coast.

Independencia Bay is a remarkable loch, fourteen sea miles in length, enclosed by high ranges on three sides, and protected on the fourth by a line of rocks and islands extending from Santa Rosa at the south end to the mountainous pile of Vieja Island at the other. The Serrate and Trujillana entrances are navigable for vessels of all classes, and the average depth of water within the bay is in the neighborhood of twelve fathoms. I was told by sailors of the 'Alcatraz' that the British Pacific fleet had entered the bay during the war, and had lain, hidden from the world for a number of days, behind the screen of Vieja. Whether or not this story is true, the sheet of water might well furnish a spy-proof retreat for half the navies of the globe, for there are no human settlements in the vicinity, and fishermen rarely come so far south from Pisco and San Andrés, which are seventy miles away by water and utterly inaccessible by land. Everything considered, this fiordlike bay is probably the best natural harbor along a coast to which nature has given few protected anchorages; but, unfortunately, the hinterland does not measure up to the sea approach. At the famous Peruvian harbor of Chimbote, the only other sheltered haven of large size that I recall, a highway and railroad lead directly from tidewater to the valleys of the Santa,

Huaras, and Chuquicara rivers, and thence short passes reach the Amazonian drainage of the Rio Marañon. At Independencia Bay, on the other hand, the bold ridge of Carrasco and many a long mile of bare and rugged hill country separate the sea from the fertile Ica Valley, which, moreover, is adequately connected with a port by way of the "back door" railroad from Pisco. In short, Independencia Bay, hemmed in by mountain walls, lying midway in a hundred-mile stretch of seacoast which lacks both streams and the habitations of men, is barred by geographical circumstance from becoming the site of a maritime city.

The leeward side of the bay, including the easterly coast of Vieja Island, is steep and shingly, but the windward part of the mainland shore is bordered with a splendid sandy beach upon which huge flocks of gulls and North American migrant shore birds were feeding at the time of my visit. This strand also teemed with smaller forms of life, including mollusks, sea cucumbers, annelids, crabs, and legions of the small "sand fleas" (*Emerita analoga*), known to the Peruvians as *mui-muis*. Noteworthy among the mollusks was a giant mussel (*Mytilus chorus*), which attains a length of nine inches, and which is considered one of the best of Peruvian edible shellfish. These were so thickly packed in the white sand that the crew of the 'Alcatraz' might have filled a boat with them. Wherever the sand gave way to rocky shores, black,

shortspined sea urchins abounded. They were popular shellfish with the crew of the trawler because excellent *tortillas* can be made from the livers. Inside the hard cases of each of these echinoderms we discovered a single, round-bodied, parasitic crab, which filled part of the alimentary tract of the urchin, and was, perforce, a prisoner for life, for it was far too large ever to emerge through the natural opening in the shell. This peculiar crab is the female of a species related to the well-known oyster crab. It enters the body of the sea urchin when in the minute, free-swimming stage, and prepares to reside permanently in the belly of its unwitting host, thereby stealing not only its lodging but also its nourishment, for it absorbs part of the surplus food that the urchin draws out of the water. The male of this crab always remains of small size, and it is believed that it temporarily enters the body of the urchin in order to fertilize the female, though, so far as I can learn, the life history of the strange creatures has not yet been worked out from direct observation.

From the deck of the 'Alcatraz' we frequently lowered baited nets into eight or ten fathoms of water and obtained such loads of large swimming crabs that we could scarcely haul them out; in fact, the bottom of the bay was swarming with crustaceans of several kinds. One species, which was particularly toothsome when boiled, was *Ovalipes bipustulatus*, a crab not previously recorded from

Peru, but known from Chile, New Zealand, and Japan, localities in which its food value is fully appreciated. Dr. Mary J. Rathbun, of the United States National Museum, reports that my specimens of this crab from Independencia Bay are apparently the largest ever collected in any part of the world.

Multitudes of fish, flocks of gorging guanayes and other birds, numerous otters, and herds of foraging lobos, completed the marine life association of Independencia Bay. Fish seemed always to be pouring into the Serrate inlet, school after school, only to pass through the long bay with the current, streaming back into the Pacific by way of the Trujillana exit at the northwestern end.

The shores of Independencia Bay have no fringe of salt-resistant vegetation such as thrives along the crest of the beach at Paracas Bay. A feature common to the two water fronts, however, is the abundance of lizards, which swarm in the intertidal zone, dodging through the interstices of the water-worn stones with alacrity. Many were seen upon isolated, weed-grown rocks which had half their bases in the bay. Examination of the stomachs of several lizards showed that they seek the damp stones for the purpose of capturing flies, doubtless such species as breed in the cast-up seaweed.

Much of the eastern border of Independencia Bay is lined with deep shell beds, in which the calcareous parts of unimaginable myriads of fossil

mollusks are cemented into pudding-stone so firm that in some places the top of the weathered bank overhangs the base by as much as twenty feet. These homogeneous beds extend back from the water-front as far as the hillside, which rises at a sharp angle to a height of three thousand feet. Cleaving the shell deposits quite to their foundation are many wide fissures, caused probably by seismic disturbances, while several remarkable caves penetrate them from the shore. I entered one of the latter, which might have passed for a home of Palæolithic man. Its entrance on the beach was almost closed by a sand dune, but the walls within were twice my height, and the ceiling flat. A green turtle shell, the remains of a flamingo, and some long-abandoned dried bonitos and stingrays lay on the floor. The cave must once have been the headquarters of some of the fishermen who, according to the chart and pilot book, occupy the "huts of Tungo" in Independencia Bay, but about whom nothing is known by present mariners along the coast.

Early on our third day, we shifted the mooring of the 'Alcatraz' to Windy Cove (*Bahia Ventosa*) at the southeastern end of Independencia Bay. It was a cloudy, exceptionally calm morning, with atmosphere of rare clearness. Even before we came to anchor I had a foretaste of a memorable experience, for far to the eastward beyond the wide, crescentic beach, in a lagoon under the yellow hills

of the coast range, I could see several faint, blurred, pink spots which were later to resolve themselves into feeding flocks of magnificent flamingos.

We landed upon the flood plain which stretches south-eastward in the form of a triangle between the hills. Its surface was mostly dry, but thousands of stranded mummified mullets, five or six inches in length, lay on the baked, gritty mud, and bones of seals, porpoises, and whales were scattered everywhere. The larger whales on the flood plain, represented by three or more skulls, several half-buried spinal columns, and numerous ribs and vertebræ, were apparently humpbacks. I could not but wonder as to the agency which had distributed such huge carcasses hundreds of yards behind the present ridge of the beach. Was it accomplished by floods due to high spring tides, by earthquake waves, by the excessive piling up of waters driven before prolonged westerly winds, or by an even more profound cause—such as the sudden uplift of the bottom of the bay due to some rapid change in the unstable coast?

Garua began to fall soon after we came ashore at the flood plain, and continued through most of the morning. Captain Mendeguren, Lurquin, two of the Indians, and I approached the distant flamingos from five points, hoping thus to be able to get near enough to photograph them. The flamingos had their eyes upon us as well, for when we drew within half a mile, they all became restless,



GUANAYES AT THEIR NESTS, ASIA ISLAND.



MELITÓN LURQUIN WITH TWO CONDORS OF SAN GALLAN.

and one group of fourteen birds took wing. Two other bands held their ground, standing with heads high, watching us. When we reached the hither shore of the lagoon in which they were feeding, the tall, rosy birds were scarcely four hundred yards away, while the soft silt on our side was covered with fresh imprints of their feet. It is doubtless for mud-walking rather than for swimming that flamingos require the ample webs which connect their toes. With Lurquin approaching rapidly from the right, through the water of the lagoon, the birds now sprang into the air, and passed over my head on their stately flight up the bay. They presented an imposing spectacle as they fell at once into an orderly file. The neck and legs drooped slightly, making a curiously sinuous body line such as is characteristic of no other bird. This appearance was accentuated by the bent bill, which was a conspicuous mark even at long range. Across the lithe, pink bodies the vermilion, black-tipped wings beat in a leisurely and majestic manner; I could not turn away my eyes until the birds had all but faded out of sight.

The total number of flamingos that I had positively counted was sixty-three, but several flocks seen subsequently probably comprised other individuals; and, moreover, the miles of their footprints along the horseshoe beach led me to believe that there may have been several hundred birds in the vicinity. During the middle of the day we observed

many bands of from four to ten, in wedges or in single file, circling at high altitudes over the bay, and returning eventually to spots not distant from the place where we had first flushed them. By stalking alongshore behind the sand dunes, I crept very close to a group of a dozen which were standing up to their feathers in the small breakers, while gulls floated and bobbed about among them. How gorgeous they looked at short range! And with what rigid yet courtly movements they raised one foot after another, making a figure four of their legs, and at the same moment swaying forward their graceful necks in terpsichorean rhythm!

On our final day at Independencia Bay, Bahia Ventosa justified its name, for in midafternoon southerly gusts, rushing down from Morro Quemado, began to make the 'Alcatraz' jerk sharply at her anchor chain. When I dined on deck with Captain Mendeguren, howling williwaws blew the soup out of our spoons. Before dusk, however, the puffs of wind first slackened and then died away, to be succeeded by the usual peace of a Peruvian evening. By the time the sky was sprinkled with stars, the bay had become so quiet that I could hear only the resonant lapping of water along the iron flanks of the 'Alcatraz,' and the mournful crying of a gray gull on the shore beyond Serrate Channel.

CHAPTER VIII

THE HUMBOLDT CURRENT

It will be apparent from many references in this narrative that the Humboldt Current, which flows northward along the Pacific coast of South America, is responsible for striking phenomena of the distribution of life. It is no less responsible for the existence in Peruvian coastal waters of a vast abundance of marine plants and animals, upon which are dependent in turn unsurpassed fisheries resources, as well as the great guano industry. Investigations in the Humboldt Current strike, therefore, at the roots of important problems of natural history, of the geographic range of life, and of the application of science to economic affairs. The purpose of this chapter is to consider these subjects in the light of my own field work.

The problems involved are oceanographic, and can not be discussed without the use of more or less regrettably technical language. Unless they are faced, however, the factors which control the climate and the animal life of the west coast will be

unintelligible. The traveler feels the effects of the current as soon as he enters it; he notes at the same time a sudden and extraordinary change in the world of life about him. Such matters become the common ground of conversation and inquiry on the promenade deck of every steamship. But real explanations are not easily obtained, because they are to be found in no book of travel and because the pertinent literature is both scattered and highly scientific.

For an understanding of conditions in the Humboldt Current, the oceanic circulation of both northern and southern hemispheres must be considered together; and, moreover, the circulation of the western coast of both Americas must be contrasted with the opposite expression of the same causes which we find on the Atlantic side of the continents.

Owing to the progressive increase in the eastward speed of the earth's surface from the poles toward the equator, currents of air or water moving in the direction of the equator necessarily fail to maintain an easterly trend equal to that of the latitudes at which they are successively arriving. In other words, they "fall behind" or turn toward the right in the northern hemisphere, and toward the left in the southern. The converse is true of currents moving away from the equator or in the direction of the poles. These elementary facts explain why the trade winds blow respectively from the northeast and the southeast, rather than from

due north and due south; they explain also why the general movement of both atmosphere and ocean water is "right-hand" or clockwise in the northern hemisphere and "left-hand" or counterclockwise in the southern hemisphere. The same relative conditions can be reproduced experimentally by pouring fluid over an orange spinning at the end of a string.

The primary results of these circumstances, which are less complicated than they may sound, are that in middle latitudes the movement of ocean currents along the east coast of both North and South America is in the general direction of the poles (e. g. the gulf Stream), whereas on the west coast the flow is toward the equator. It follows that in the Atlantic coastal region tropical oceanic conditions spread far to the northward and southward, roughly through 60° of latitude. In the Pacific, on the other hand, coast waters of high temperature are squeezed into a belt of barely 30° of latitude in breadth, owing to the intrusion toward the equator of cool currents from both the north and the south. In fact, the only characteristically tropical Pacific waters in contact with the coast of America lie in a narrow zone between Ecuador (latitude 3° S.) and the Gulf of California.

The Humboldt Current is a northerly branch of the Pacific antarctic drift, and in both extent and influence it is perhaps the most remarkable of

oceanic streams. It owes its origin chiefly to the prevailing westerly winds of high southern latitudes, and to the meteorological whirl of the eastern South Pacific. It is particularly noteworthy for its sustained low temperature. The apparently anomalous circumstances were first noted by Alexander von Humboldt in 1802, when the great cosmographer observed surface temperatures of about 60° F., at Callao in the early part of November, readings which were astonishingly different from others taken in the outlying tropical Pacific. It has since been determined that the mean annual temperatures of waters close to the shoreline of central Peru are, in fact, at least 20° F. lower than the theoretical values for the latitudes.

The current laves the western coast of South America from a point somewhere south of 40° S., to the vicinity of the westernmost projection of the continent at Point Pariña ($4^{\circ} 40'$ S.), whence the main branch sets westnorthwestward, flows on both sides of the Galápagos Islands, and is lost beyond longitude 100° west in the south equatorial drift.

Significant features of the surface waters in the current are, first, relatively low temperatures in close proximity to the land, with rising temperatures off-shore along lines perpendicular to the trend of the coast; and, second, extraordinary uniformity of temperatures throughout the greater part of the length of the current, a uniformity which is little affected by either latitude or season

of the year. Both of these facts would of themselves strongly suggest that the low temperatures close to shore are due to upwelling from polar-fed bottom waters rather than to the actual northward transportation of subantarctic surface waters. The conditions are totally unlike those of warm currents, such as the Gulf Stream and the Brazil Current, which undoubtedly carry identical masses of water for great distances. It must be borne in mind that oceanic streams of the latter type are in their entirety surface flows, which usually if not always rest upon layers of colder and denser waters.

Recent researches have made it clear that the low surface temperatures in the inshore areas of the

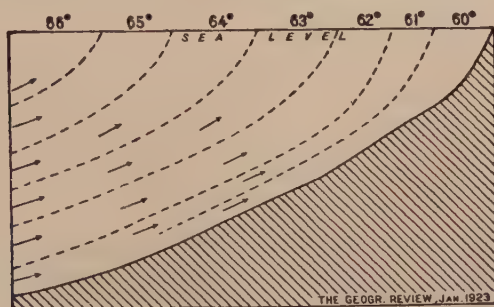


Diagram illustrating the probable relation between the upwelling of bottom water and decreasing shoreward temperatures in the Humboldt Current. Width of cross section approximately 10 sea miles.

California Current are due exclusively to upwelling of bottom water caused by the broad belt of north-

westerly winds along the Pacific coast of North America. Such winds, acting upon a principle previously referred to, cause the moving water to swing gradually toward the right, or off shore, whereupon it is replaced by water from deeper layers. In like manner south of the equator, an accelerated left-hand trend, and continuous vertical circulation, are caused in the Humboldt Current by steady southerly winds, parallel to the coast, which tend to force the surface water off-shore at an angle of 45° from their path. For the same reason, and also because the submarine slope of the continent shoulders off to seaward the warmer and lighter surface waters of a deep, impinging stream, the water closest to shore is the coldest. The steeper the coastal slope, the greater the reduction of surface temperature, for the narrower and more concentrated is the belt of upwelling bottom water.

During my five months field work in 1919 and 1920, I recorded upwards of 300 surface temperature observations in the Humboldt Current at points between Independencia Bay ($14^{\circ} 18' S.$) and the northern waters of Peru ($4^{\circ} S.$). The records, considered with those of other observers, lead to the following conclusions: (1) that only very slight latitudinal changes in the surface temperature of the inshore coastal water occur along the whole length of the Peruvian coast between Molendo and Paita (1,000 nautical miles); and (2) that

the small observable variations are due chiefly to local influences, and only in much slighter degree to seasonal conditions. Earlier investigators have established the fact that the uniform temperature conditions of the Peruvian coast are carried southward in the Humboldt Current at least as far as Valparaiso, Chile.

Average temperatures within five miles of shore along the greater part of the coast of Peru range between about 58° F. and 64° F. throughout the year. At times, however, irregular variations are apparent locally, or even extensively, such changes being commonly attributed to a shifting of the course of the Humboldt Current, that is to influences which cause the stream to swing temporarily off-shore. This assumed phenomenon is almost universally accepted as a fact in Peru. The alleged aberrations are recognized by the native fishermen through the effect upon the catch of anchovies, bonitos, or other fishes; and by the inhabitants of coastal towns through the effect upon climate. Exceptionally warm weather at Lima—such as obtained, for example, during part of the winter season (June-Sept.) of 1919—is credited in popular opinion to the retreat of the current from the coast.

It is my belief that such phenomena are to be interpreted in another way. Many observers, from the days of Fitzroy, commander of the 'Beagle', to the present, have noted that an alteration, or

reversal, or "set to southward" in oceanic circulation along the Peruvian coast is likely to occur from time to time, and that such changes often coincide with or follow northerly winds. We have abundant evidence that the friction between atmosphere and ocean produces a quick response. The normal conditions in the Peruvian littoral are due to prevailing southerly winds which, except for the well known day and night swing, vary remarkably little from one year's end to another. When, however, this meteorological control temporarily gives way to northerly winds the warmer off-shore waters are driven toward the land at an angle of 45° , and an immediate effect is seen in the cessation of upwelling. Moreover, the fact that the eastward pressure of the Humboldt Current is literally blocked by the half-submerged Andean wall, makes the explanation just given more satisfactory than the pure assumption that the current sometimes shifts its course to westward, an assumption which has perhaps been made through false analogy with the very different hydrographic system of the Atlantic Gulf Stream.

Paracas Peninsula and San Gallan Island ($13^\circ 50'$ S.), which project into the Pacific at the "bend" of the Peruvian coast, appear to mark the boundary between two regions of somewhat different oceanographic character. To the southward of this point conditions in the coastal water which depend in the main upon constant upwelling attain their greatest

uniformity; to the northward the generally stable equilibrium is at times disturbed not only by such relatively insignificant fluctuations as have already been referred to, but also by influences of a more profound nature. Especially to the northward of Salaverry ($8^{\circ} 13' \text{ S.}$), seasonal influxes of warmer waters from equatorial regions sometimes raise the temperatures considerably above normal over wide areas. The advancing tropical waters form a counter-current, which is known to the inhabitants of the coast as *El Niño* (The Child), because it often becomes evident about Christmas time.

This counter-current made its appearance at the time of my field work among the northern Peruvian islands, in January 1920. On the second of this month, the average of surface temperatures taken off Pacasmayo ($7^{\circ} 24' \text{ S.}$) was 60.4° F. Two weeks later (Jan. 15 and 16), however, temperatures obtained in the same area averaged approximately 69° F. The explanation is that the warm waters of *El Niño* had overflowed the northern end of the Humboldt Current in the interim.

The counter-current has long been an object of interest to navigators and other observers in Peru. It has been discussed in many issues of the Bulletin of the Geographical Society of Lima, beginning with the first volume in 1892, and its imperfectly known characteristics are recorded in the Peruvian pilot books of Melo and Stiglich. Stiglich and other Peruvian writers infer that the

counter-current proceeds from the Gulf of Guayaquil in freshet season, but the volume of water in this source would be insufficient to account for the observed effects. The current should be attributed rather to the periodic changes in barometric pressure which occur when the sun is well south of the equator. Aside from the previously noted increase of ocean temperatures off Pacasmayo, my field notebook contains numerous inferential references to the southward extension of *El Niño* in January 1920. Among these are the following:

1. The captain of the Chilean steamship 'Husco' testified that on January 10, while passing northward between the Lobos Islands ($6^{\circ} 27' - 6^{\circ} 56' \text{S.}$), the course of his vessel was perceptibly affected by a strong north-westward set of the Humboldt Current. On the following morning, however, off Sechura ($5^{\circ} 35' \text{S.}$), he encountered an adverse current, flowing southward past Paita, and noticeable thereafter along the entire length of the coast of Ecuador.

2. On January 24, near the Guañape Islands ($8^{\circ} 35' \text{S.}$), when the temperature of the surface of the ocean was 67.5°F. , or from 6 to 7 degrees higher than it had been on Jan. 1, many *mantas* or large rays were seen leaping from the water into the air. As a rule these somersaulting fishes are to be observed only in the extreme northern waters of Peru, north of Point Pariña. Their jumping is a common phenomenon in the tropical ocean off Ecuador. Near La Plata island ($1^{\circ} 16' \text{S.}$), for instance, I noted them in great abundance on Sept.

5, 1919, and again in early February, 1920. The commander of the 'Huasco' maintained that the migration of the jumping rays down the Peruvian coast as far southward as Salaverry and the Guañapes, is always coincident with other manifestations of *El Niño*.

3. On January 24, large numbers of dead piqueros were observed along scummy drift-lines extending for miles to the *southward* of Macabí and Guañape Islands. Ordinarily the lines of foam produced by the rocks and islets of the coast stretch away to the northward, and the dead birds, chiefly nestlings which have fallen from the cliffs, are carried rapidly in the same direction by the flow of the Humboldt Current.

The problems of the counter-current have recently been attacked by my friend Señor de Lavalle, of the guano administration, in relation to a peculiar disease of the Peruvian guano birds, which he has diagnosed as "aspergilosis." This malady appears at intervals of years, and its visible effects have been mentioned from early times in maritime books and in the logs of ships. During the outbreaks countless numbers of the sea birds die upon the breeding ground or the water, their bodies subsequently washing ashore by thousands and strewing the beaches for many miles.

De Lavalle attributes the disease of the birds, together with the meteorological and oceanic changes which ordinarily precede its appearance, to the southward advance of *El Niño*. After calling attention to the fact that the temperature of the

tropical current is normally not less than 9° F. higher than that of the most northerly waters of the Humboldt Current near Cape Blanco, he remarks that fish and nearly all forms of small marine organisms are killed by abrupt temperature changes of this magnitude. Correlating his hypothesis with phenomena observed in 1917, or recounted in the literature of the subject, de Lavalle evolves a rational exposition of the relation between the advance of the counter-current, accompanied by changes in ocean temperature, atmospheric humidity, etc., and its secondary effects such as the mortality of fish and birds and the irruption of the renowned "Callao Painter." The latter phenomenon, which is known also as *aguaje* and *agua enferma* (sick water), is a sulphuretted emanation from the ocean which stains the white paint of ships and even that of houses situated near the waterfront.

The northern waters of Peru are undoubtedly affected every year, and perhaps several times a year, between December and April, by incursions of the current from the north. An advance of pronounced intensity, however, seems to take place only a few times in a generation. In 1891 the counter-current flowed with a strength which is still remembered, stranding palms, alligators, and other tropical flotsam on the beach at Pacasmayo, and bringing such unfamiliar meteorological disturbances as thunderstorms far down the desert coast.

De Lavalle points out that the *aguaje* or "Callao

Painter" is equally unknown in the tropical waters off Ecuador and in the cool, southern Peruvian littoral, south of Paracas Peninsula. These facts, taken in connection with the established seasonal coincidence, are sufficient evidence that the "Painter" is indeed due to changes caused by the counter-current. In general the "Painter" is confined to the stretch of water between Paita and Pisco, and more especially to that between Pacasmayo and Callao. Its immediate cause, according to de Laval, is the accumulation of enormous quantities of marine organisms, killed by the rise of the ocean temperature, in protected localities where, owing to the coastal contour, eddies exist. The bay of Callao is one of several such places. Here the penetration of the sun's rays into the shallow water hastens decomposition of the mass of organisms, which are so thick as to discolor the ocean. Active production of hydrogen sulphide and other gases result, and for a while the affected areas become as poisonous as the depths of the Black Sea.

The sequence of changes which culminate in a "Painter" causes the destruction or departure of the huge shoals of migratory fishes which are so characteristic of the Humboldt Current. During the Chilean occupation of northern Peru, after the War of the Pacific, so vast a quantity of dead fish was cast on the beach near Eten during the prevalence of an *aguaje* that the whole region became insuf-

ferable. The Chilean troops occupying Chiclayo had to be ordered out to bury the decomposing fish in a trench which extended from Eten to Pimentel (10 geographical miles).

It is easy to understand, therefore, the effect of the counter-current upon the fish-eating sea birds of the Peruvian coast. De Lavalley states that in March, 1917, before *El Niño* had become perceptible about the Guañape Islands, but after it had been reported farther to the northward, great numbers of pelicans arrived at Guañape, having abandoned their feeding grounds in the neighborhood of the Lobos Islands at the approach of the warmer water. Shortly afterwards, the total sea bird population of Cabinsas ($12^{\circ} 09' S.$) fled in like manner from their threatened territory and settled at Pachacamac and Asia Islands (respectively $12^{\circ} 19' S.$ and $12^{\circ} 48' S.$) The ultimate fate of all birds which do not migrate in this way to the "safe" waters of the southern half of the Peruvian coast is a loss of food supply, and a lowering of vitality which renders the victims an easy prey to infectious pulmonary disease caused by a fungus, *Aspergillus fumigatus*, or by related organisms. If the counter-current continues its advance as far south as the Pisco Bay region, hundreds of thousands of the priceless guano birds may perish before the rhythms of nature restore favorable life conditions throughout the field.

It should not be forgotten that cataclysmic dis-



GUANAYES OF SANTA ROSA ISLAND POURING FORTH TO FEED IN THE SERRATE CHANNEL, SOUTHERN ENTRANCE OF INDEPENDENCIA BAY.

turbances, such as have just been described, obtain at only rare intervals and are the exception rather than the rule. Extraordinary uniformity is, after all, the outstanding oceanic feature of the Peruvian littoral. The very fact that relatively slight fluctuations toward the border line of a distinct region so profoundly affect the whole life association of the Humboldt Current, is, in itself, evidence that this life must have become thus inflexibly adapted through the long duration of substantially invariable conditions. In the cosmic scheme the annihilation of a myriad sea birds and lesser organisms is a trifling incident; almost before the effect can be appreciated, the circulation changes, the cold, upwelling waters are reinvaded by new hordes; and within a few days or weeks the old order reigns again, heedless of the Damoclean sword, from Mollendo to Point Pariña.

Essential uniformity in the Humboldt Current is indicated by temperature data alone, but confirmation drawn from a study of the microscopic marine plants known as diatoms—"the grasses of the sea"—may serve to emphasize the prevailing physical stability.

My tow-net collections, together with samples of bird guano of various ages and from several different islands in the Humboldt Current, were submitted to Dr. Albert Mann, of the Carnegie Institution, who has reported by letter upon their diatom content. The diatoms pass into the

digestive tracts of the birds chiefly by way of the fishes. Some of the guano samples were excavated in deep, so-called "fossil" beds on Lobos de Afuera and Lobos de Tierra, where they must have been deposited so long ago that their age can be reckoned only by centuries. Both the ancient and the recent guano, as well as the material collected in tow-nets along some 700 miles of the coast, proved to be rich in diatoms. The point of particular interest is that all of this material, whether collected in October or in February, whether at Independencia Bay ($14^{\circ} 15' S.$) or near the Lobos Islands ($7^{\circ} S.$), whether captured in the haul of a silk net or extracted from guano deposited by four or more species of sea birds an hour, a month, a year, or five hundred years before—contained the same characteristic species of diatoms. Dr. Mann writes: "There is considerable similarity between the different guanos in the species of diatoms they contain. In fact no sample stands out as radically unlike the rest, as would be the case were the plankton flora of the ocean a totally dissimilar one at any of the periods of time represented by any one of the samples. This in itself is interesting; because it is no infrequent thing for the diatom flora of a given locality to be strikingly dissimilar on two successive years. Thus the diatoms of Woods Hole, Massachusetts, were very different in 1920 from those found in 1919."

The lowest surface temperature which I recorded

at stations between Independencia Bay and the Gulf of Guayaquil was 58° F., a figure obtained at various times and places. Close to mainland or insular shorelines, and in situations open to free circulation such as the straits south of Callao and Pisco, the exposed southern entrance of Independencia Bay, etc., the ocean was almost invariably cool. In passing from the sheltered waters of Pisco Bay through the constricted *boqueron* which separates Paracas Peninsula from San Gallan Island, surface temperatures in November 1919 were found to decrease ten degrees Fahrenheit or from 68° F. to 58° F.

Distance from the land, or in any direction away from an exposed islet in the Humboldt Current, is usually concomitant with increase of surface temperature. When traveling parallel with the mainland coast, a mile or more off shore, an observer finds that water temperatures are likely to be lower abreast of a projecting headland than they are off a bight. In short, the lines of equal temperature follow the turnings of the coastline, and a boat bound along shore repeatedly cuts the isothermic curves. Such observations indicate that the upwelling waters are being continually deflected seaward as they strike exposed bottom slopes of the continental shelf.

80° F., or thereabouts, is close to the yearly mean temperature of the water off the Ecuadorian coast, and also of the *off-shore* waters of the more

southerly tropical Pacific, outside the zone of upwelling, at least as far to the southward as the latitude of central Peru. Captain Paul Hoffman, commander of a German vessel, found, for example, that surface temperatures of 64.9° F. at Callao rose progressively to 81° F. at 135 nautical miles from shore.

Stiglich states that the mean breadth of the Humboldt Current along the coast of Peru is about 150 miles, a figure which, from a navigator's point of view, is doubtless roughly correct. We have records of very few temperature observations along lines extending across stream to the warm outlying ocean, but the readings of Captain Hoffman, and other data, show that the belt of cool water is extraordinarily narrow when compared with conditions in the corresponding region of the North Pacific. The fact is confirmed, furthermore, by studies of the life of the Humboldt Current, for the characteristic algæ, as well as the invertebrates, fishes, and higher forms of life, are all confined to waters near the coast.

Recent investigations in the California Current, by the hydrographic staff of the Scripps's Institution for Biological Research, reveal an order which is at striking variance with that of the Peruvian littoral. The California Current, at least off the southern Pacific coast of the United States, is a remarkably broad stream, the effects of which can be detected a thousand miles from shore. Again,

the principal zone of upwelling, and consequently of lowest temperatures and greatest profusion of marine life, lies far off the coast, in sharp contrast with the respective conditions off the west coast of South America.

The explanation of these contrasts, which are at first puzzling, is doubtless to be found in the very different relative trends of the Pacific coastlines of North and South America, and in the dissimilar topography of the respective continental shelves. A glance at the map, especially at a globe, will show the great divergence of the coasts of the Californias from the course of the clockwise, or right-hand, southward-flowing current. The coast of Peru, on the contrary, trending sharply to westward from near the Chilean border, extends far into the ideal course of the Humboldt Current, and forces the latter to become an actively impinging stream until it has passed the end of the continental buffer at Point Pariña. A chart of ocean depths throws further light on the causes of dissimilar zones of upwelling in the two hemispheres. The South American coastal shelf, between Valparaiso and northernmost Peru, is narrower, more steeply terraced, and far less irregular along its outer border, than the west coast of North America. Since upwelling is most pronounced where the transition from deep to shallow water is most abrupt, the reason for the low ocean temperature very close to the Peruvian coast is obvious.

Existing information regarding the rate of flow of the Humboldt Current has been derived mostly from the reports of seafarers whose reckonings have been thrown out by this disconcerting and largely unmeasurable factor. The pilot books rather vaguely assign a velocity of "15 miles per day," a "general set of $\frac{1}{2}$ to 1 knot," "a speed of one mile per hour throughout the year," etc. The effect of the flow is, of course, universally recognized as favorable or adverse in navigation, depending upon the direction of a voyage. In the words of Coker, "the fisherman returning along the coast from a short trip to the north feels the force of the current distinctly. Steamers on the coast maintain a ten per cent. higher fare for the southern journey than for a trip northward of the same length. Even in a small boat lying at anchor near an island the water may be observed to flow by like the current of a river. An equally striking manifestation of the current is gained when one observes from the heights of an island, such as one of the Guañapes, the line of surf-made foam streaming constantly away to the northward."

I made numerous attempts to measure the rate of the flow with a current meter. The readings taken under the more favorable circumstances gave velocities of from .64 to 1.4 statute miles per hour, the average being .91 miles.

Captains of *caleteras*, or coastwise steamers which call at all the Peruvian ports, informed me

that the current is a factor to be seriously considered in steamship navigation only in two parts of their route: the first along the southerly coast of Peru, northward from Mollendo, and the second on the reaches between Eten and Point Aguja, in the north. In the latter region, according to the testimony of one captain, the stream frequently maintains a northwesterly rate of one knot for days together. These reports are in harmony with theory, for we might expect the maximum rate of flow where the coast trends to westward and thus deflects the centrifugal pressure.

All of the physical characteristics of the Peruvian coastal waters offer favorable life conditions for a great profusion of marine organisms. In the first place, the low salinity, due to the upwelling of water more or less polar in origin, and more particularly the low temperature, facilitate the absorption of atmospheric gases and the retention of those produced by the physiological processes of oceanic plants and animals.

Again, low salinity makes possible the solution or suspension of increased proportions of silica, which, together with nitrogen compounds and phosphoric acid, is among the nutritional substances upon which all life in the sea is ultimately dependent.

The reduction of buoyancy due to lowered salinity is more than made up by the increased viscosity resulting from low temperature, viscosity

being the most important property of sea water for preventing the descent of minute forms of life to unfavorable levels. Other things being equal, water at a freezing temperature offers twice as much resistance against sinking as water at 77° F.

Finally, the stable temperature of the littoral water, except during the rare invasion of *El Niño*, results in an environment which is far more uniform than that along most of the temperate Atlantic coasts.

The organic source of all food in the sea, for creatures of the depths as well as those of the surface strata and of the atmosphere above, is the microscopic plant life, comprising mostly the brown algæ and diatoms, which, obtaining their sustenance directly from nitrates in the circulation, build up tissue that becomes the food of small crustaceans, certain fishes, etc., which, in their turn, are devoured by higher animals. In the presence of sunlight the microscopic plants, moreover, assimilate the carbon of carbonic acid and restore the oxygen to solution, thus bettering the conditions for animal life. Under favorable circumstances, these plant forms may number as many as 40,000 individuals per quart of ocean water. They exist principally in a layer within fifty fathoms of the surface, though they may sometimes penetrate three or four times as far, and their dead remains are uninterruptedly settling into the lightless depths. But vertical circulation, which is continually bringing

masses of deeper water to the surface along the inner border of the Humboldt Current, is thereby steadily restoring food substances, in the form of decomposition products, to the upper layer of the ocean. Here, if not directly available for the algæ and diatoms, they may be utilized by bacteria, and worked over into material which enables the profuse development of other plant life to go on. The quantity of the latter is directly proportional to the amount of upwelled water. It is for this reason that marine areas in which ascending currents occur are favored with the most prolific efflorescence of both micro-organisms and higher creatures. On the other hand, surface life is always least abundant in anticyclonic or dead-water regions, like the Atlantic Sargasso Sea, where the surface layers continually sink.

It is upon such a causal sequence that the life of the Humboldt Current depends, a sequence beginning with the energy of the sun, and continuing through barometric pressure, winds, oceanic temperature, circulation, density and salinity, bacterial action, the presence in the water of substances essential in small quantities for sustaining life, the physiology of microscopic sea weeds and the consequent building up of complex proteins suitable for the food of small forms of animal life. In this chain the diatoms are the connecting link with the animal world. They surpass in bulk, or annual productiveness, all other aquatic plants a thousand-

fold. They are everywhere available as pasturage, and because of their abundance they represent the sole food supply of certain animals and the partial sustenance of many more. They are highly nutritious, and there are no deleterious species.

Thirty-five years ago the oceanographer Buchanan wrote, "No waters in the ocean so teem with life as those on the west coast of South America." More recent investigations have borne out this statement. An impression of the unparalleled abundance of marine animals, particularly of fishes and birds, will be gained, it is hoped, from other chapters of this book. In summing up the circumstances, I need only state that along the Pacific shores of South America, as far northward as the Humboldt Current extends its influence, various animals are present in well-nigh incredible numbers; and that, for reasons already considered, the vast population does not decrease in the usual manner with the approach to equatorial latitudes.

Next to the extraordinary abundance of marine life in low southern latitudes, the predominant zoological characteristic of the Peruvian littoral is to be found in the unequaled northward distribution of antarctic or subantarctic types. Examples which illustrate this fact are also given in another chapter.

As the Humboldt Current is a narrow stream, it need hardly be added that the composite range of the typical marine fauna of the Peruvian coast

is likewise a narrow ribbon of ocean, hugging the shore, and projecting toward the equator from the far south. If we sail out across the current, we encounter a change in fauna which is closely correlated with change in surface temperatures; after a few miles the rich "soup" of microscopic life, the sea lions, the penguins, cormorants, kelp gulls, and subantarctic petrels—an aggregate of thousands of species—all disappear. A new oceanic region, with a distinctive assemblage of life, rich in species, perhaps, but poor in the relative number of individuals, spreads away across the vast expanse of the tropical South Sea.

CHAPTER IX

SAN GALLAN

EVERY notable experience of mine in Peru began and ended in a boat, a circumstance to be expected in a land of few coastwise railways. It is natural, therefore, that the pleasant memories of each successive adventure should be associated with the personality of some sea-going craft, whether a nameless and deckless *bote de pescador*, manned by ragged Indians and propelled by a clumsy lateen, or a ten thousand ton steamer of a transequatorial line. 'Mantaro,' 'Alcatraz,' 'Mazorca,' 'Cachapoal,' 'Paquito,' 'Guañape,' 'Piquero,' 'Mollendo,' 'Huasco,' 'Guatemala'—names which mostly commemorate birds, rivers, ports, states, and islands of the Hispanic New World, and which to me conjure up a trance of the far-off, kaleidoscopic Peruvian Andes, and the northward-rolling swell of the Humboldt Current. Daily life seemed to be so much a matter of transferring effects from one deck or cabin to another, that, after six or eight

weeks, I began to feel closely akin to Charles Niehorster, head guardian at North Chincha Island and captain of the little schooner 'San Pedro,' who during seventeen years on the Peruvian coast had put his chest of clothes ashore but once! Since he had first taken to the deep-sea, this estimable skipper told me, he had spent only three short periods on any continent—a year in California, and again in Peruvian towns for tedious terms of four months and eighteen days, respectively.

After the return from Independencia Bay, I dwelt for some days upon North Chincha, in care of Charlie, two Indians, and a genial black man whose chief virtue lay in his ability to walk for a minute and a half at the bottom of eight or ten feet of water while he hauled the outer end of my seine off the yellow beach. Charlie himself caught many interesting fish for me, and also carried my motion picture outfit all over the rugged island. He was a powerful, broad backed, Holland sailor, of somewhat piratical Nordic type; in short, a Viking living after his time. He had been pretty much over the world, though seldom far from a planked deck, and he spoke five languages—one as badly as another, he truthfully stated. He considered every kind of bird and sea-creature edible, not excluding cormorants, vultures, and condors, and he was rather proud of certain culinary secrets which were alleged to disguise the natural flavor of fishy fowl. During the guano-digging season

Charlie had been in charge of the waterboat gang, and was responsible for transporting to the Chinchas fresh water to supply the needs of several hundred men. The labor was extremely arduous, and he explained to me that he had long ago adopted the policy of selecting only the stupidest of the Indians as his own workmen, his philosophy being that if he chose blockheads, and taught them nothing, they would never become fit for other work. By such brilliant tactics he had kept the same dull, steady crew for years, and not a man of it had learned enough to leave his laborious job for another.

Charlie had absorbed considerable store of natural history during his long experience on the coast. Part of his fund of observation he interpreted correctly, but other of his conclusions were proof that things are not always what they seem. He had, however, a weatherforecasting sense even more uncanny than that of most elderly sea-dogs, an accomplishment all the more noteworthy because of the prevailing equability of the region. On two different November evenings, when the skies were almost cloudless, he predicted a fall of garua, a phenomenon far rarer at the Chinchas than in the mainland valleys. I asked the reason for his prophecy, and he replied, "The stars are boiling." To my eyes the celestial sparks twinkled no more than usual, but, on the daybreaks that followed his auguries, an atomized mist was whirling down

from the gray vault above the islands, just as I had seen it in Lima.

At five o'clock in the morning of November 26, 1919, I was awakened by the shrill whistle of the launch 'Mazorca,' which had come unexpectedly to take me to San Gallan, the lofty isle whose red mountain was the most conspicuous landmark at the other end of Pisco Bay. We hurried to Central Island, and a little later chugged out through the western entrance of the strait, and southward against a great swell which concealed the world from us when we were in the hollows. As we passed La Goleta, near the South Island, a magnificent *mar brava* was dashing upon the rocky sails of these schooner-like pyramids. The high waves that we encountered were due, however, not to a local wind, but rather to heavy weather offshore toward the southwest.

The northern shoreline of San Gallan is a long, concave beach, very steep and composed of large cobbles. Behind it a pebbly and sandy plain stretches back into the principal valley, which divides the mountainous island into two parts, of which the western is the larger and higher. When we came within sight of the beach, we could see numerous herds of sea-lions sunning themselves just beyond the water's edge, so I hastened to mount the Akeley camera on the 'Mazorca's' bow. We then drew as close as possible to the barrier of breaking waves, and I took two hundred feet of

film of the lobos on the beach, and of the dense and noisy schools swimming out towards us. Not less than five hundred of the animals crowded about the launch, without showing alarm. Ashore we could see many mother seals with young, some of which were kissing, or pressing noses affectionately together. The old males seemed to be the most alert and wary; it was evident, too, that their actions more or less governed those of the females and "pups," for whenever a stampede for the water took place, the stentorian bulls drove all the weaker animals before them into the waves. Among the groups of lobos on the beach I noticed a flock of turnstones, another of nineteen Hudsonian curlews, and several gulls and vultures.

Off the northwest corner of San Gallan, at the outer end of the long beach, lay a cluster of sugar-loaf islets, some pierced by archways and some with blowholes which were belching out tall streams of spray with every swell of the sea. Between San Gallan and the largest of these outliers, the waves of the open Pacific met the independent waves of the northerly, leeward bight, the opposing rollers butting directly against each other to form high, foam-topped ridges which rushed laterally shoreward. Here, in the shallow strait, was an extraordinary sight when sea-lions crossed in one direction or the other. The sleek creatures would ride surf-board fashion over the shoals, balanced in the belly of a wave, and, when the moment of collision



STRAGGLING LINES OF TILLANDSIA GROWING DOWNWARD FROM THE FOG-ZONE OF
SAN GALLAN ISLAND TOWARD THE LIMIT OF VEGETATION.



VIEJA ISLAND, INDEPENDENCIA BAY, PHOTOGRAPHED FROM SANTA ROSITA ISLET.
The fog of the windward peak, where plants grow, can be seen dimly.

arrived, they would be tossed high before they could slip through the wall of water and hurry to the depths beyond.

We landed with difficulty upon San Gallan by means of a tender which had been carried across the stern of the 'Mazorca.' While we breakfasted ashore, the first condor, for which the isle is famous, flew grandly over the cliffs above, making us all the more eager for the climb to the misty hilltop.

We walked through the gently sloping, sandy valley, which was filled here and there with diving petrel burrows, and then turned up the steep, bone-dry hillside toward the rocky central summit. At a slight elevation we encountered the first straggling, stunted growths of the bayonet-leaved epiphyte, *Tillandsia purpurea*; and, at a height of 1100 feet the desert, with its hot stones and resounding crust of alkaline salt, abruptly gave way to a rock garden such as a landscape architect might well take as an inimitable ideal. On this peak the crumbling granite was exposed in chaotic piles, and here, within a layer of cool, moist air, were fully a dozen species of plants with buds, flowers, and fruit all together. Three of them I had already seen on the crests of Isla Vieja, in Independencia Bay, but the others were all new. Butterflies, grasshoppers, land snails, and lizards dwelt among the rocks and the vegetation, while every crevice and small patch of soil had its aggregation of petrel tunnels. To one who had been living upon the bare low guano islands,

the fresh, verdant scene and the smell of foggy air were a delight. But the best was yet to come, for while we stood looking over the black roof-ridge of a lower, northward range toward the gleaming white Ballestas and Chinchas, half enveloped in a purplish haze, and with a cobweb of foam-streaks stretching away from them in all directions over the translucent, jewel-like bosom of the Pacific, five condors appeared from nowhere and circled round and round our heads, sometimes coming within the range of a tossed stone. Feverishly I worked the Graflex, with the hope of perpetuating some faint shadow of that experience! For fifteen or twenty minutes these harpies of the Andes remained in the neighborhood, returning again and again to the peak to inspect us, and now and then swooping down the gulley below, so that we could see the white on the backs of their tooth-edged wings. Turkey vultures, which suddenly looked very dwarfish, were also soaring above the heights, but, in my exultation over the greater birds, I thought with a tinge of contempt of how hard I had worked to photograph mere red-headed *gallinazos* only a few days before.

The flying condors made good use of their long necks, twisting their heads either sidewise or up and down. They seemed to be able to look directly behind them for considerable periods while forging ahead at full speed, and there was no doubt that they evinced much curiosity over

their human visitors. The working of their broad, stiff tails was a conspicuous feature of the mechanics of their flight. This member rotated as a highly mobile unit, and was never still. Instinctively I found myself comparing the aëronautics of this greatest of land birds with those of the ace among sea-fliers, the wandering albatross. The latter, unlike the condor, is a functionally tailless bird, which must do all of its steering and adjusting with its planes. The condor is a loose-jointed, flexible flier; the albatross a stiff, rigid glider. In a very light breeze the broad wings and fanlike tail of the condor still enable it to soar slowly and with relative steadiness; in the same air the narrow-winged albatross would either have to bank continuously, or to beat its wings. This is the explanation of the erratic, rocking flight of the albatross and of many shearwaters. The great albatross is, of course, incomparably swifter than the condor. Its weight is but half the condor's and its breast muscles vastly less in bulk. In effect, it needs only sufficient muscle and tendon to lock its planes in position, and then, unless the air be quite calm, its marvelous control of gravitational momentum enables it to go where it will.

At San Gallan, and elsewhere along the coast of Peru, the condor and the vulture are true birds of prey as well as scavengers. The fresh wings and still bloody breast bones of diving petrels,

which were strewn all over the mountain, indicated that these unfortunate creatures contributed substantially to the condor's food. Gigantic footprints, reminding one of a dinosaur rather than a bird, were, moreover, impressed all over the petrel breeding grounds, showing where the condors had walked from one burrow to another, as if to sit, ogre-like, and await the exit of an unsuspecting victim.

Perhaps a score of condors were seen during our sojourn on San Gallan. An old, crested male, shot by Lurquin, weighed $26\frac{1}{2}$ pounds, and measured a fraction of an inch over ten feet in the expanse of its outstretched wings. This is from two to three and a half feet less than the wingspread of an adult South Atlantic wandering albatross. The male condor's eyes were grayish brown, while those of two females were garnet red. The stomach of the old cock contained an odd assortment of remains, which have since been identified by Dr. W. L. McAtee of the United States Biological Survey. They comprised ten large pebbles, fragments of a penguin, the hoof and a few bristles of a domestic pig, two leg-bones and some cartilages of a fur seal (*Arctocephalus australis*), and bits of kelp. The definite trace of the southern fur seal constitutes my only record of this rare animal during five months on the Peruvian coast. Two other condor stomachs contained scales and bones of fish, as well as the bodies of

diving petrels, thus confirming the indictment we had brought against them in advance.

When we returned to sea-level, after our first ascent of San Gallan, we found difficulty on the hard and steep surface of the hillside to keep from being precipitated like dislodged stones, which first rolled and then bounded, leaving little puffs of dust in their wake, until they disappeared in the dead valley far below. We made no central sleeping camp on the shore, but at night each man (there were six of us) carried his bed-roll away from the fire to the spot that pleased him best.

In the cold starlight, on the barren beach,
Where to the stones the rent sea-tresses clave,
I heard the long hiss of the backward wave
Down the steep shingle, and the hollow speech
Of murmurous cavern lips.

WILLIAM WATSON.

I remember nothing more until the piping of oystercatchers waked me at dawn of the second day. A pair of these handsome, decorative, black-shore birds, with their long coral bills and yellow eyes, were standing on the crest of the beach near by, and, judging from their behavior, I had doubtless spent the night close to their nest. They proved to be particularly common residents along the rockbound coast of San Gallan. They were very musical at this time, the beginning of their breeding season, and piped equally loudly while

flying about and while tripping over round, slippery stones momentarily exposed by the backwash of the waves. Seafarers of the Peruvian coast say that the piercing, excited calling of the *brujillos* or "little wizards" is a sure sign of high surf. The birds have a softer, sweeter song, in the form of a very rapid tremolo, which my boatmen always distinguished as an expression of contentment, meaning no surf. The interpretation is that heavy breakers interfere with the feeding of the oystercatchers, and that the loud, reiterated notes are a complaint.

With Lurquin, and an Indian to carry the Graflex, I made a second ascent, by way of a gulch from the main valley, reaching the heights more quickly and easily than on the preceding day. At an altitude of 750 feet, we came to a cliff which dropped directly to the sea and formed part of the western face of the island. Here, on a sandy col riddled with petrel burrows we stopped awhile to watch nine condors, which, with three or four times as many turkey vultures were idling in the bright morning air, now high overhead, now far below towards the sea, where the low-flying piqueros looked as though they were under the surface of the clear, sapphire ocean instead of above it. The white combers made a sharp line on our side of the ineffable blue. Off towards the southwest, the position of the sunken and dreaded Piñeiro Rock seemed merely a milky cloud in

an inverted sky. Only the screams of gulls softened by distance, and the tortured, wailing conversation of sea-lions, broke the silence of the hills.

Leaving the rocky central peak of San Gallan on our left, we climbed a succession of steep, sandy hillocks and gently sloping gullies towards the western headland. The gullies were everywhere filled with the holes of diving petrels, and there seemed to be much guano in the deep beds of æolian soil, which had doubtless been an undisturbed breeding site for ages. The abundant lizards appeared to dwell in harmony with the petrels, often scampering into burrows which we found to be occupied by incubating birds. In many places, indeed, the bright-eyed heads of the lizards protruded from half the burrows that we passed. The hillsides along our route had elongate, parallel, sinuous rows of *Tillandsia*, and on the summits, particularly wherever there were outcrops of weathered granite, many of the other native plants also became conspicuous, the best growths being on the northerly or lee exposures. I collected herbarium specimens of all of this vegetation, including grasses, epiphytes, blossoming mallows of several sorts, and a small entire-leaved fern, but the identification of the material has proved exceedingly difficult and has not yet been completed at Kew, England. It is noteworthy that cacti, which are an important element of the

flora of the mainland coastal ranges, are wanting at San Gallan and at the other lofty Peruvian islands.

At the tip-top of San Gallan my aneroid registered 1320 feet. Looking down the slopes and valleys, the most striking marks on the terrain were the innumerable clusters of black dots which represented the round mouths of the repeatedly mentioned petrel burrows. The aggregate numbers must be enormously great, in spite of condors, marauding fishermen, and *zorras* or wild dogs, which occur only upon San Gallan of all the Peruvian islands. From four feet above sea-level to the pinnacles, in the damp soil of seepage areas behind the beach, in the detritus at the base of the precipices, on the hard upper slopes of the hills, and in the midst of the succulent vegetation of the cloud zone, the island is indiscriminately drilled full of holes. By day there are nothing but burrows and bones to suggest the existence of the *potoyuncos*, and the large proportion of empty nests might give even a naturalist the impression of extinction; but at night the air rings with their purring voices and vibrates with the whirring of their wings.

I remember vividly the evening at San Gallan when, on strolling from the campfire to the base of a hill which rose from the beach, I first became aware of the living presence of myriad ghostly creatures which were soon determined to be diving petrels. Out of the talus came low, froggish



PESCADORES ISLAND.

A natural tunnel and guano-covered slopes, with small clusters of birds.



BARRIER OF ROCKS AT THE NORTHWEST CORNER OF SAN GALLAN ISLAND.

songs. Whichever way I turned along the slope, the chorus of elfin voices continued to resound in my ears. When I fetched a lantern I soon found the crevices that led to the burrows, for the weird songs were not interrupted even by a light at the entrance, and flying birds, perhaps attracted by the glare, fluttered past and darted into the ground. It was not practicable to get at the nest-chambers here, because of the protection afforded by the rocks, so Charlie, Lurquin, and I made a trip in the darkness to the entrance of the main valley. Except where the earth was encrusted with salt, we could now dig into the petrel homes very easily, and I captured a dozen or more specimens. The tunnels were variable in course and depth, but most of them led down steeply from the entrance for about a foot before beginning their level, twisted path to the enlarged nest-chamber. The blissful singing of the birds continued while the digging progressed, but when they were hauled out they screamed angrily. A few of the burrows proved to be empty, but within most of them we found either a bird and an egg, a bird and a chick, a chick alone, or two adults. The noisiest holes, if they may be so described, usually contained a love-making pair. When the captive birds were put into a burlap sack, some of them resumed their song, but not so contentedly. All the while additional *potoyuncos* were streaming in from sea.

When we left San Gallan, on a late November afternoon, wading waist-deep in order to launch our skiff through the surf, a condor circled high over the bight. We headed the 'Mazorca' toward the Ballestas Islands for a visit to the flourishing guanay and pelican colonies, which I had not previously inspected, and resumed the voyage to the Chinchas after the *paraca* had died away. The sunset was typical of the region, the season, and the meteorology of the day. Against a clear west were a few little solid-looking, gilded clouds, modeled as if in high relief. The azure of the zenith blended imperceptibly into greenish, yellow, orange, red, and magenta toward the horizon beneath the sun, which was a naked, clean-cut ball, glowing like a dull coal and hardly bright enough to dazzle the eye. It seemed so near that one might have expected to hear it sizzle as it touched the sea. When it was half below, a piquero with partly folded wings dropped like an arrow straight across its face; and when the bird burst from the water the sun had gone.

CHAPTER X

ASIA ISLAND AND THE CENTRAL COAST

By the end of November, I had completed field work in the vicinity of the Chinchas and was eager to begin the voyage toward the northerly islands of Peru. Guano operations in Pisco Bay were finished for the season, and Central Chincha was not again to be disturbed for a period of thirty months. The paraphernalia of the guano administration upon the island had been left ship-shape; ironware, such as cars, steel rails, buoys, and tools, had been cleaned of rust and painted with red lead; barrels had been scraped and tarred, and all movable objects stored in the iron-roofed buildings or stacked under burlap and a layer of sand. The 'Alcatraz' had called for the final deck-load of laborers including Pancho, the indispensable, water-carrying donkey, the human exiles to return with accrued earnings to their bleak motherland in the Andes, the poor burro doubtless to continue its lonely, mateless, and vociferous existence on some other guano island.

It so happened that the launch 'Mazorca,' which was now my sole means of returning to Callao, made a farewell call at the port of Pisco at a time when a political holiday, a Sunday, and a religious fiesta fell in succession. The result was quite to be anticipated; the sailors of the 'Mazorca' entertained themselves by indulging freely in the colorless and innocuous-looking *pisco* which originates in this section of the coast. While I watched impatiently by day from the summit of Central Island for the low hull of the returning boat, or at all hours of the night strained my ears for its expected whistle, it lay bobbing at anchor off the end of the long Pisco pier, its supposed occupants on shore and engaged in "breaking training" with a vengeance after their weeks of rigor and abstinence at the islands.

On the afternoon of December 3 the launch puffed into the strait, towing the rowboat in which Captain Charlie Niehorster had as a last resort dispatched two Indians to learn the cause of the vexatious delay. All hands were incoherent but enthusiastic. So much time had been lost because of their carousal, however, that it was decided to postpone our trip no longer. We left Central Island an hour before sunset, stopping at North Island to take a tender in tow. At this time of evening the resident birds filled the air and covered the ocean about the Chinchas, but the day's struggle for food seemed to have ended and all were

at peace. The gleaming sand-hills of Paracas Bay, the purple heights of San Gallan, illumined by the mellow rays of the late sun, had never before seemed so satisfyingly beautiful. Running before a breeze from south by west, we were cozy and comfortable, and did not feel the usual evening chill. As we headed offshore, La Goleta, La Yegua, and San Gallan appeared to swing across successively to the westward of the Chinchas, which were ever so gradually enveloped by dusk and distance. A whale spouted very near us, and sea lions came up and snorted close astern. Most of the home-coming birds seemed to be flying intently toward the islands, but the piqueros, which knew not the meaning of satiety, tarried now and then to dive. The sun went down against a cloudless band of red and lavender, as it had done almost daily since the southern spring had grown old. High above, rafts of golden mackerel scales floated against a background of white, frayed feather-clouds. The dark blue east, spotted with sky-windows of very pale blue, the richly tinted billow-clouds opposite the sun, and the moon, veiled behind thin wisps, were no less entrancing than the bright west. At seven o'clock there was no land on our horizon.

It now became apparent that not a member of the watch was in physical condition to steer a true course. We were towing a heavy boat before a moderately great swell from the southwest, which made the helmsman's task doubly difficult. More-

over, the compass lay upon the cabin floor, where it was hopelessly affected by vibration. The engineer, bending drowsily over the instrument, took turns with other muddle-headed fellows at the wheel, but the wabby track of the 'Mazorca' soon indicated that the sensitive craft had caught the spirit of her crew. All others who realized that we were in difficulties took it very cheerfully, but when I discovered from the heavens that we had turned *south*, I felt obliged to give some gratuitous service. On my own chart I laid the course for Santa Barbara, and then sat on top of the cabin half the night, with my small luminous compass in hand, calling out directions to Hipólito, the patient even if somewhat dazed helmsman. This worthy and experienced coast-man, who knew the shoreline of his country from Tumbes to Mollendo, was now relieved of all responsibility except that of bearing upon the wheel as he was told, and he kept the 'Mazorca' approximately on her course while his companions snored.

At midnight we made out the lights of the British Sugar Company's plant at Santa Barbara, and, since the crew had by this time partially recovered their senses, I slept for an hour.

At two o'clock in the morning Hipólito sighted Asia Island. As we approached it, we frequently ran down lone pelicans asleep on the water. In the pale, misty moonlight the buoyant birds loomed up like galleons. We had intended to pass between



Motion picture film.

ADULT PIQUEROS AND FULL-GROWN FLEDGLINGS AT THE EDGE OF A PRECIPICE,
FOUR HUNDRED FEET ABOVE THE PACIFIC. SOUTH GUAÑAPE ISLAND.



THE CROWN OF PESCADORES ISLAND. GUANAYES, OLD AND YOUNG, TOWARD THE
END OF A BREEDING PERIOD.

the eastern shore of Asia Island and the mainland coast, but Hipólito, who could not for the moment recall the position of certain perilous rocks in the strait, lost his courage; so we turned westward and encircled the island to a cove on its northeastern side. We had the light of the moon almost to the anchorage, and, as soon as it had set, the cloudy sky suddenly cleared and became luminous with stars. Near shore the water was full of phosphorescence; a lobo burst forth, as if from a molten firmament, and then plunged again in pursuit of the fiery comets whose heads were fleeing fishes. We dropped anchor at three o'clock near a dimly seen sloop. Again I stretched out on the forward deck, and remembered only the delirious piping of a pair of oystercatchers until I awoke at seven.

Asia proved to be a rugged island of irregular outline, with several steep, rounded hills. The loftiest of these has an altitude of 403 feet, or twice the height credited to it on the charts and in the various pilot books which I have consulted. Almost from the summit of the high hill a narrow ravine drops straight to a rockbound, sunless cove; it is as though the guano-covered pile were a frosted cake from which one fair-sized portion has been cut away. The landing place is sheltered serenely, with a sloping beach virtually devoid of surf; and numerous islets off the eastern and northeastern shores make quiet and picturesque tidal channels in which droves of the long-tailed black cormorants

disport themselves. North of Asia, too, a chain of outlying rocks extends along a wild and mountainous coast toward Punta Chilca.

Asia is nearer the mainland than any other important guano island which I visited in Peru, the intervening strait being less than two nautical miles in width. On this part of the Peruvian coast spurs from the maritime cordillera jut out toward the sea, and the view from Asia of painted, castellated peaks and ridges, beginning close to the ocean and piling up like Ossa on Pelion toward the exalted horizon, is wonderfully impressive. By these colossal stairs, it was easy to imagine, the condors had found their way down from the spires of the continent to such an insignificant mound in the Pacific.

The narrow coastal plain between the mountains and the strand appeared, as I looked from the island, to be covered with green foliage, an anomalous condition for an untilled valley of the seaward slope. Still more luxuriant vegetation lined the courses of small rivers to both the northward and the southward. These streams are doubtless responsible for the greenness of the plain as well as for the abundance of mosquitoes, which often become a pest at Asia, making the screenless sleeping quarters miserable and infecting the workmen with malaria. Long before reaching the island I had been warned of its unhealthfulness, which contrasts with the notable salubrity of nearly all the other

guano islands. I had also been told of the existence at Asia of extraordinary numbers of bats, and had, not unnaturally, attributed their presence to that of the mosquitoes. I soon found the bats, clinging like burs to each other and to the roofs of dim caverns in the rocks, with age-old heaps of bat guano underneath; but, to my surprise, there was not an insect eater among them. They all turned out to be vampires or blood-suckers of one species (*Desmodus rotundus*), the same which I had already captured upon the Chinchas, and at Isla Vieja in Independencia Bay. When asses or dogs are brought to Asia, their hair is often found to be blood-soaked in the morning, a memento of nocturnal visits of the silent, painless, winged leeches which, not content with drawing off the vital fluid of their victims, leave a small circular wound, from which a cap of skin has been snipped clean away, and which may continue to bleed long after the vampires have filled their degenerate, baglike bellies and departed. Neither men nor domestic animals are sufficiently numerous at Asia and other Peruvian islands to account for the presence of these bats, and I infer that they must parasitize either the sea lions, which spend many hours slumbering on the rocks, or the larger birds, such as shags and penguins. The latter supposition is the more probable because it is related that in some parts of South America no poultry can be kept on account of the ravages of vampires which attack

their combs and cause them to appear white from loss of blood. Whether the bats have an important economic status as an enemy of the guano birds has not yet been determined.

At the time I had passed Asia on my southward journey in October, the entire seaward face of the island had been black with courting guanayes; but before December 4, the date of my landing, great destruction had been wrought by gulls, vultures, and condors, all of which were more abundant and rapacious here than anywhere else. Although a colony of guanayes with eggs and young still covered about half of the western slope, extending from the summit almost to the water, and filling a deep gulch as well as the rounded hillside, the other half had become a waste of empty nests and broken egg-shells, and had been deserted for the season by the parent birds.

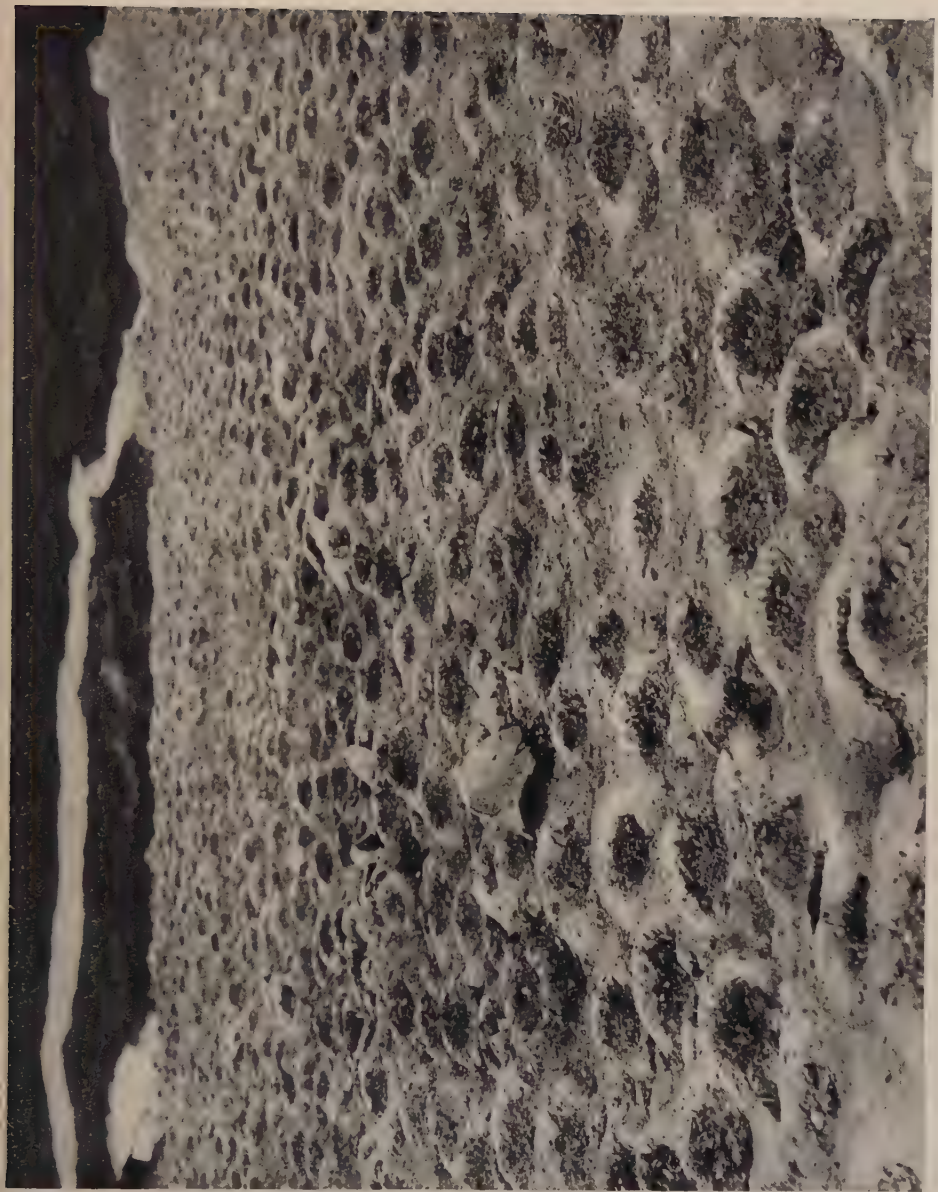
Many condors were seen in the air during the morning's reconnaissance. At one time I counted 18 flying back and forth slowly over the guanay colony, or in and out of the adjoining chasm from which issued muffled reverberations of the waves. Sometimes three or four of the crested birds alighted in groups, either on the ground amid crowded nests or along the rocky brinks of cliffs. Among those which I photographed as they soared back and forth above me, were several whose bare, distended crops hung down like goiters from the weight of stolen eggs within them. Before noon

all the condors retired together to the mountains of the mainland, and we saw no more of them.

From my point of view as an ardent ornithologist, it had at first seemed criminal that sharpshooters, like Meliton Lurquin, should be employed for the express purpose of killing such magnificent creatures as condors. But, after witnessing the damage that these birds had done at Asia, my sympathies inclined more toward the victims and the practical attitude of the guano administration. An area of several acres, which had recently been peopled to the usual degree of density by nesting guanayes, had been swept clean by condors, the season's normal increase of guano-producers being thus cut down probably by tens of thousands. Lurquin informed me that he had once seen 36 condors descend together upon the guanay colony at Santa Rosita Island. It is obvious that unless such formidable enemies were frightened away through the destruction of all that come within range of a guardian's gun, the steadily augmenting annual tonnage of Peruvian guano would soon drop off. If it be asked how the balance between guano birds and vermin regulated itself in ancient times, when gulls and condors presumably enjoyed unrestricted banquets, the answer is simply that the cormorants, piqueros, and pelicans could, in that pristine period, well endure such a process of elimination. Man has since upset the scheme of nature so seriously that he must, for the present at least,

vigilantly apply a system of more or less artificial culture.

While it was still dark on the morning of December 5, we regretfully hove up the 'Mazorca's' anchor and resumed the northward journey. Barely perceptible cats-paws fanned me into a rather pleasant state of chilliness which lasted until beams from the rising sun worked over the edges of a cloud bank, covering the soft gray Pacific with sparkles, and limning the ghost of a horizon between the western hazy sea and hazy sky. So quiet, so delicately adjusted, was the atmospheric equilibrium that the smoke from a southbound steamship hung in a level, threadlike line above the ocean for miles and miles. Small gulls and Inca terns were straggling across our path from the direction of the lilac hill-tops of the coast, which seemed merely to float, without bases, above a mirage-like silver band. The terns stopped characteristically to hover above the slopping backs of humpback whales, and to flutter over "slicks" through which the black, tossed-up flukes had slipped silently below. Sleepy-looking groups of phalaropes floated upon the languorous swells, wholly unheeding the approach of the sputtering launch until we had fairly run them down, when they leaped from the water as lightly as though they had been perching upon twigs, and whisked away with an air of abused confidence. Now and again we encountered a potoyunco, a shearwater, a foraging jaeger in pursuit of worried



HAVOC CAUSED BY CONDORS IN THE GUANAY COLONY ON ASIA ISLAND.
The eggs and newly hatched chicks had recently been devoured in many thousands of nests.

terns, or a skipping Mother Carey's chicken. Abreast of the point of Chilca, herds of lobos, beasts which know neither night nor day in their hunting, had waylaid a school of a billion or so of anchovetas, and were beginning the morning auspiciously by eating passageways through the mass of hapless fishes.

As the sun climbed, the wind increased, blowing from the northeast or against the set of the swell and causing the 'Mazorca' to pound and slap from trough to trough of the shortened waves. By the time we reached the island of Pachacamac the ocean had become unpleasantly choppy, but we steered close to shore so that I might review the cohort of scething guanayes, comparable only with a swarm of bees covering the surface of their hive. Upon the slopes of the island there seemed to be all the birds that it could well hold, yet endless files were returning southward from the direction of the Morro Solar, black lines which, when blended by distance and perspective, filled the sky with rippling streamers. Above the peak of San Francisco Island, south of Pachacamac, a condor was circling and rising on the wind.

From Pachacamac it was but a short run to gloomy Fronton, on which we could see the low buildings of the penitentiary. Here, as Hipólito remarked, the stone-breakers have all the time between now and the Day of Judgment to reduce the high isle entirely to granite paving blocks! Then

through the Boqueron and round the Whaleback Reef of Callao we chugged, past a fleet of weather-beaten German square-riggers (rotting in the roadstead like dead flies in an old spider web), under the bow of the venerable cruiser 'Almirante Grau,' across the sterns of two rusty-looking Peruvian submarines, and into the maze of small craft which filled the carenage in front of the custom house landing. Elbowing through a mob of solicitous *fleteros*, I found an official who examined my credentials and passed the motley cargo of equipment and cases of specimens through the customs. After transporting these by cart to my wareroom in the *Depósito San Enrique*, I returned to Lima, which was just entering fully into the season of roses and uninterrupted sunshine.

CHAPTER XI

PERUVIAN FISHERIES

It is pleasant to lounge at sunset on the upper deck of a steamer in the quiet roadstead of Callao, and to watch the fishing fleet put out to sea. A score of craft in each compact group, with courses parallel and tall lateen sails at the same tilt, they stand away through the Boqueron, or past the outer point of San Lorenzo Island, until the red sky fades beyond them and the flotillas are gathered into the darkness offshore. While landmen sleep, the fishermen may sail twenty-five or thirty miles toward the southwest. Sooner or later they throw their seines across the phosphorescent, zig-zag tracks of the bonitos, streaks as crooked and angular, and almost as rapid, as the lightning which wriggles down from a low-hanging storm cloud. To see these erratic, glowing lines in the dark-blue night waters of the Humboldt Current is to acquire a new conception of the speed of strong, voracious fishes, and of the extreme irregularity of their hounding paths. When the moon shines

brightly, the phosphorescence of the ocean is dimmed by the surface glimmer, and the shoals of foraging fish are more difficult to find.

Always the outward bound fishing boats of Peru point their bows in a more or less southerly direction, against the current and the steady, coastwise breezes, because a sense of comfort and security can be enjoyed only when the home port lies "down the wind." If a fisherman is so unfortunate as to be carried far to the leeward of his base, he may be obliged to spend weary days in beating back again, for in neither hull nor rig is his boat adapted for sailing close to the wind. During a sojourn on the Pescadores or Fishermen's Isles, I could look down from the vantage of a high hill, and see every afternoon the setting forth of the fishermen from Ancon. Each brown-skinned man sat in the middle of his trim *chalupa*, and steered with a very long tiller. The boats, with centrally placed masts, carried mostly a sprit-sail and a jib. When favored by a brisk breeze they could run to windward of the main island of Los Pescadores, but on calmer days the lack of a centreboard prevented them from holding to the true course, and I would see the fishermen standing amidships, pushing hard on a lee oar, and creeping close around the northerly coast of the isle. Once outside the shelter of rocks and promontories, they would swing to the southward and slowly disappear, with the pink flush of the sun upon their canvas. Sometimes they

returned in the night, before the merry push of both wind and current. If fish were not promptly located; however, they might remain on the high seas for two or three days, alternately working to windward and drifting with a sea-anchor hanging from their bows. Sometimes, in fact, the fishermen of Ancon and Callao go as far as Hormigas de Afuera, or "Ants off Shore," 38 sea miles west of the continent. Here, I was told, it is possible to haul out boats and to wait near the fishing grounds for a favorable turn of weather or of the mysterious conditions within the sea which, in the belief of the fishermen, cause the current to swing now toward the coast, now far away, with correlated movements on the part of certain pelagic fishes.

Few littoral waters of the globe teem with fish and with other edible products as do those of Peru, and yet in no other enlightened country are fisheries more restricted to methods which, with one illegal and disastrous exception, are such as St. Peter may have followed nineteen centuries ago. Although the fisheries, no less than guano, offer a rich field for modern development, there is not a single organized fishing industry along twelve hundred nautical miles of stormless coast. Sea food is universally appreciated in Peru; Dr. Coker writes that "rarely is a meal served without fish where it is obtainable, yet to a large part of the people beyond the ports this much-prized luxury is seldom to be had." I observed many times at the boat-landings that no

gratuity seemed more welcome to a *fletero* or a porter than a handful of fish, whether fresh or cured. Indeed, at Eten, Pimentel, and elsewhere, I have seen the stevedores scramble for the privilege of carrying ashore the luggage from a native boat, when the only reward that each man craved was one or two of the small dried sharks brought from fishing settlements on the Lobos Islands.

With the wealth of an extraordinarily productive ocean at their door, the Peruvians import their stock-fish, such as cod, from countries within the northern hemisphere. The waterfront fish-stalls of Callao are, indeed, well patronized, and a considerable quantity and variety of fresh fish are distributed through the great public markets of the capital; but the price of all but a few kinds is so high as to be prohibitive to the majority of the inhabitants. Two species, the bonito and the anchovy, may be classed as staples; for the rest, the greater part of the aggregate catch in Peru is consumed in the communities of the Indian fishermen themselves, or in those of their more opulent near neighbors. In short, the coastal aborigines, continuing the immemorial customs of their ancestors, subsist upon a wide variety of sea products which comprise nearly all available kinds of fishes, as well as of mollusks and other invertebrates; the individual landmen of the seaboard towns utilize first the bonito and the anchovy, and after these a limited number of dried or salted sea foods; while



Photograph by F. M. Chapman.

FISHERMAN AND CORMORANTS, BAY OF CALLAO, WITH THE ISLAND OF SAN LORENZO
BEYOND.



Motion picture film.

LAUNCHING CABALLITOS, OR REED BOATS, IN THE PACIFIC AT PACASMAYO.

the well-to-do Peruvians confine their salt-water diet chiefly to a small selection of the most toothsome fishes, such as the flounders, corvinas, and pejerreyes (silversides). The only shellfish which is commonly classed with such expensive delicacies is the scallop.

With regard to the reasons for the fastidiousness of an important proportion of the population, the unequal utilization of sea food among the various classes of society, its relatively high cost in the seaports and its extreme scarcity everywhere else, the following paragraph by Coker is suggestive:

That the resources are unstudied is not attributable to their inadequacy or to the failure of the people of Peru properly to value them, for Peru possesses a wealth of certain valuable forms, and no people could be more highly or more generally appreciative of fish food; nor is it because they have any recent origin that the industries are little known. In fact there is reason to believe that centuries before the Columbian period the occupation of fishing was pursued in Peru not simply as an unorganized food hunt, but as an important industry. Therefore neither the natural conditions nor the nature of the people can account for the scant knowledge of the fishery resources or the inadequate state of the industry. The explanation is found rather in the unfortunate history which has burdened the country since the overthrow of an earlier social and industrial life. It is only recently that a stable government has been able to give serious and effective attention to the many phases of the industrial life of the nation, and to include in its many en-

deavors the effort to conserve and develop the valuable resources of the sea.

To hark back to ancient times, when the aboriginal Peruvians were probably no less proficient in fisheries than in agriculture and the textile industry, tradition says that the Incas had devised a means of conveying fresh or even living fish from the waters of the Pacific to the imperial palace at Cuzco. As indicative of the extravagant valuation sometimes placed upon fish within the historic period, we may quote Mendiburu, who states that in the days of the viceroys a thousand pesos were once paid for a single fish.

The present unsatisfactory condition of the Peruvian fishing industries is due, in brief, to certain underlying social and historic causes connected with the former unstable economic condition of the Republic; to the primitive methods employed, and the lack of fish products plants of any description; to the difficulties of transportation in a land of few railroads; to the scarcity and high cost of manufactured ice; and to the national, monopolistic control of the salt supply.

The Peruvian fisheries as they exist to-day represent a somewhat decadent native system slightly influenced by Mediterranean methods. The vast majority of the fishermen are pure-blooded Indians, whose equipment is doubtless not greatly different from that of the days of Pizarro. Such

modern modifications as are found have been introduced mainly by maritime settlers of Italian stock, who now more or less predominate in the fisherman's vocation at the important centers of Ancon, Callao, and Chorillos. The ordinary *chalupa* or *bote de pescador* of central Peru is a Mediterranean type of craft—a double-ended, seaworthy boat, of broad beam, with no centerboard, and a clumsy sailing gear. The centerboard, which would be a device of particular usefulness in this region of constant coastwise winds and currents, is unknown in Peru. The chalupas are used in all branches of the line and net fisheries, as well as for dredging, and in spite of their intrinsic shortcomings, they are so well fitted out with the necessities of sea life that they serve as homes for the fishermen during voyages which, as has been hinted, sometimes take them for several days far from land. A mile off the yellow beaches of Lobos de Tierra Island, almost out of sight of the coast of Sechura, I have seen fleets of the fishing boats anchored for a week or ten days at a stretch, the craft filled to the point of discomfort with mackerel fishermen who would not, perhaps, set foot on shore until they had returned to their village of San José. At Ancon I have looked down from the pier upon the chalupas in their haven, where the completeness of their household equipment could be fully appreciated. Their narrow decks were filled with a succession of neat compartments, and the cockpits

served as cabin and galley no less effectively than as forecastle and hold. Their orderliness and sufficiency were never shown better than when the skippers produced iron charcoal braziers from some cubbyhole and proceeded to cook a tasty stew of potatoes and the red, beeflike flesh of the bonito, to be washed down, perhaps, with a bottle of *chicha*, or native maize-beer.

Other, more ancient types of craft used in the Peruvian fisheries, are the *balsa*, the *canoa*, and the *caballito*. The *balsa* is nothing more than a raft made of the extraordinarily buoyant Ecuadorian wood of the same name. Sometimes balsas are large enough to transport whole families, with their possessions, and are equipped with sails; but the fishing balsas which one sees on the beaches, or carrying heaps of fish to the stewards of steamers in the northerly seaports of Peru, are usually small and unrigged. They are propelled by means of one or two broad plank-oars, which the fishermen thrust straight down into the water at the stern and use as levers against the ends of the logs.

The *canoas*, made of Ecuadorian hard wood trees, are dug-outs with planked-up gunwales. Sometimes they are forty feet or more in length. They are seaworthy when well manned, and, because of the density of the timber from which the best of them are constructed, it is said that they have a life of a hundred years or more.

The *caballito* or "pony," so-called because the

fisherman sits astride it, is a very remarkable native boat made of bundles of reeds lashed together. Coker describes it in the following words:

The "caballito" in its simplest form . . . is made of two long bundles of "totora." The reeds are individually weak and flimsy, but the bundle, which is well-wrapped with twine is strong and comparatively stiff. Each bundle is about a foot in diameter at the aft end; forward it enlarges a little, and then tapers to a point at the other end. The two bundles are securely bound with rope, and the long tapering ends curve upward in graceful form. At a short distance from the stern (about one-fifth of the entire length) the inner and upper reeds of each bundle terminate squarely to form the forward end of a small pit, where the fish may be kept. The pit, which is about a foot deep at its forward end, rises gradually to the top of the caballito near the stern. . . . The fisherman sits astride, just forward of the pit, with his legs hanging in the water or resting on the side of the boat. For a paddle he uses a plain split of bamboo, paddling with each end alternately. With its shapely taper, and up-turned pointed end, the caballito, mounted by an Indian fisherman, not only presents a picturesque appearance, but is most serviceable for use in the short swell near the beach where an ordinary boat would be unwieldy.

The *caballito* is a wonderful craft in heavy weather, riding breakers like a Hawaiian surf-board, and it is at the same time a thoroughly practical fishing boat when manned by an experienced native. A large caballito may have a

length of fifteen feet, but it is so light that, unless water-logged, a man can easily carry it on his shoulders. In the northern parts of Peru this type of craft has evidently been used as a surf boat for untold ages, for at Chiclayo and Lambayeque I saw pre-Columbian pottery vessels in the form of *caballitos* exactly like those of to-day.

In the way of fishing tackle, many kinds of seines, drag-nets and casting nets, hand lines, trawls, dredges, and grains or spears, such as are common to most parts of the world, are used by the Peruvian fishermen. The seines are of various dimensions and meshes, each sort taking its vernacular name from the fish for which it is particularly designed: thus "*pejerreyera*," a net for *pejerreyes* or other small fish; "*bonitera*," of the right mesh for the bonito; "*cazonera*," a net for *cazones* or large sharks. The casting net or *atarraya* is employed chiefly in the surf of sandy beaches, and is identical with those which I have seen in use among West Indian and Brazilian fishermen. I once watched a nearly naked Indian stand in the waves at Chorillos on a cool Sunday morning in September and throw the *atarraya* for two hours. His stocky brown figure, with the white foam swishing around it, made an attractive picture. On the sand sat his wrinkled wife, with a gay poncho wrapped about her motionless form. The gray gulls, which were so wary of me, walked unconcernedly within a few feet of her. By her side lay a covered basket

into which she tucked the fine *lenguados*, or flounders, which, from time to time, rewarded the arduous labor of her man. For every successful cast, however, he made fully fifty that were without avail.

Owing to the abundance of Peruvian marine fishes which travel in dense schools, the trident or gig is often an effective instrument in the hands of the fishermen. In late afternoon at the Chinch Islands, when the guano workmen had ceased their toil and the day wind had died down, the Indians used to congregate upon the pier of Central Island for the purpose of striking gigs into the masses of fish which oscillated in the swells below. I remember many quiet October evenings when, during the hour before sunset, vast shoals composed mostly of four species—herrings, mackerels, cojinobas, and scads—filled the shallow water near the shores of the Chinchas. All the fish were of about the same length, nine or ten inches, and, although the cojinobas appeared to be the most numerous, the four species mingled rather indiscriminately, for a single thrust would often bring up several kinds together. It was necessary only to wait until well bunched groups had gathered below, and then to hurl the Neptunic gig. When it was drawn out by its lanyard, the steel fork would usually have two or three, or sometimes more, silvery fish transfixed by the prongs. While some of the Indians were cheerily casting the gig, others were scarcely less

successful with a curious contrivance consisting merely of a weighted line with many hooks attached to it at intervals of a few inches. The line would be lowered gently to the bottom: at the opportune moment it would be jerked upward through the concentrated fishes, hooking them at random by their bellies, fins, snouts, or tails.

In the course of such fish-spearing and fish-yanking as I have just described, it often interested me to note the psychological reaction of the victims to the death-dealing instruments. When the gig was darted into the water, the creatures in its path would, of course, scatter in all directions, leaving one or more of their number impaled; but with scarcely less alacrity those which had escaped would resume their accustomed quiescence. The gig, in short, made but a transitory impression upon the consciousness of the fishes; their protective reactions were apparently reflexes accompanied by only the most fleeting impulses. On the evening of October 14, at the Chinchas, I had an opportunity to extend observations of this nature when a natural enemy of the fishes, rather than the artificial gig, was the stimulus. While the fish, chiefly herrings (*Sardinella sagax*) were massed in the calm, transparent water beneath the dock, a sea lion appeared and glided about directly below us, making a clear path over and over again through the schools. As the lobo bore swiftly down upon the fishes, the latter would dart aside as if terror-

stricken, but, astonishing as it may seem, they became quiet no less abruptly the instant that the enemy had passed, and they showed not the slightest tendency toward deserting the locality. To those who wax sentimental over the universal cruelty of nature, the scene would have been a convincing object lesson. Ruthlessness in nature is not necessarily cruel. It is obvious that the herrings in the Chincha strait, although from one point of view intended by nature to furnish the subsistence of the sea lion, did *not* live in fear of their relentless persecutor. It is equally clear that those fishes which had achieved the most hair-breadth escapes from the lobo cherished no unpleasant memories of their danger, not even for the briefest period; and that, as individuals, they acquired no profit by their experience other than their momentary safety. Life and death to them meant nothing; escape represented only the fortuitous and instinctive functioning of a reflex produced by an external stimulus (*i.e.*, the seal). Time and time again, while I looked on from a distance of ten feet, the torpedo-like lobo shot among the fish and took toll. The reaction, both individual and collective, was invariably the same—a violent spurt which carried the fish a yard or two ahead, and then a prompt return to lethargy.

The Peruvian fishermen, not content with the simple but effective equipment of their native fishery, have unfortunately acquired a new and

fearfully destructive means of obtaining larger catches with less labor, namely, dynamite, the *chinchorro americano* or "American net," as it is called with grim humor. The illegal use of this explosive, which is widespread at least in central and southern Peru, bodes ill for the future of the Republic's marine resources, for the havoc that it wreaks among schools of fishes, and especially of young fry which are not worth picking up, cannot fail eventually to cause a profound depletion of many species. Quantities of dynamite are naturally imported into Peru for use in the mines. By one means or another much of it comes into the hands of fishermen, who detonate it under water when they wish to obtain either food-fish or bait. It is used with the latter object, for instance, when anchovetas are destroyed as "chum" to attract corvinas or other large fishes to the surface, after which a second charge can be set off. In all phases of the dynamite fishing the destruction of life is generally greater than could be utilized even if a good proportion of the fish were not inevitably lost through their failure to rise or to remain afloat long enough to be scooped into a boat.

At various points of the mainland, and also during my stay upon the islands, I frequently heard the splitting reports of dynamite exploding in the sea. In the vicinity of the Chinchas such occurrences were usually coincident with the absence of the guano administration launch. In fact, I suspect

that the wily fishermen from San Andrés and Tambo de Mora regularly noted the departure of the launch for Pisco, and, at such times of comparative immunity from arrest, dropped their bombs about the outlying rocks of the Chinchas. Charles Niehorster informed me that in the years when private contractors took guano from the Chinchas, the crews of the vessels at anchor in the straits exploded dynamite continually, and that so many of the rock fish were destroyed that they have never regained their former abundance.

I myself saw fishing boats with rotten, useless seines, which nevertheless came back to port well laden with fish. On the rare occasions when the law-breaking fishermen are apprehended with the explosive in their possession, they ardently protest that they employ it only to drive off the lobos and sharks which sometimes injure their nets by attacking the impounded fish!

It was once my fortune to witness the effect of a discharge of dynamite near one of the smaller islets of Pisco Bay. The substance was removed from its paper capsule, mixed with grease, and worked into the form of a ball in the hands of a fisherman. A short fuse was then inserted and lighted, and the ball was tossed overboard in five fathoms of water. After 45 seconds it exploded with a sharp detonation, which rang against the sides and bottoms of the fishing boats. For some time nothing further

happened, but within perhaps two minutes the first of the stunned fish began to rise. They came to the surface very slowly, mostly belly upward, feebly working their jaws and fins. Thereafter, for a quarter of an hour, fish continuously appeared, to be scooped up, large and small, as rapidly as possible, the fishermen even backing their boats into the tumultuous water close to the rocks in order to lose none of the disabled creatures.

The number of the fish recovered was 142, representing about twelve species, largely sea basses, grunts, oplegnathids, and blennies. In length the individuals ranged from a few inches to nearly three feet. The most numerous victims were *cocos* (*Chromis crasma*), of which 49 were recovered, and *chitas* (*Anisotremus scapularis*), which numbered 37. All of the fishes belonged to bottom-living groups with the exception of a single pejerrey which had doubtless been killed by mere chance since the species is not a fish of the rocks.

I learned that on another occasion more than seven hundred chitas had been picked up after a single explosion of dynamite in Pisco Bay. When the fishermen throw their bombs among the hordes of free-swimming anchovies or pejerreyes, the carnage is vastly greater, and the quantity of fish lost is out of all proportion to that which is taken.

Twenty years ago Dr. Coker recommended heavy fines and the confiscation of fishing boats as

the severe penalty for fishing with dynamite, but it is to be feared that the nefarious practice is even more general to-day than formerly.

As indicated in earlier parts of this account, the fisher-folk of Peru scorn few if any of the marine invertebrates which occur in profusion along parts of the coast. Not only are scallops, oysters, mussels, whelks, crabs, and lobsters prized, but, moreover, squids and octopuses, holothurians, ascidians, sea-urchins, chitons, and the *mui-muis* or hippas of the sandy beaches, are all utilized in one form or another. The mollusks of Peru apparently furnished a considerable part of the food supply of the ancient Indians, as they do of their successors, for in graves among old burial grounds at Chorillos and Paracas Bay I found the shells of many species which are still sold in the fish markets of Callao.

Some of the mollusks which are valued for food are taken on the rocks, in the sand of the beaches, or on mud flats exposed by the falling tide, but scallops, oysters, and *caracoles* (snails) are often obtained by dredging in relatively deep water. One mollusk which formerly promised to support a valuable fishery in northern Peru, and which may once again assume importance, is the *concha de la perla viuda*, or pearl oyster (*Pteria peruviana* Reeve), the same species which is the basis of a pearl fishery in the Gulf of California.

Upon visiting so rich a seacoast, anyone with a

knowledge of fisheries cannot fail to be impressed by the unrealized opportunities for the development of desiccating, canning and packing plants in Peru. Aside from many available fish, and such species of mollusks as the giant mussel, which might be preserved for distribution in the same manner that clams are canned on the west coast of Florida, the bays of Peru abound in an unusual variety of large edible crabs, some of which are similar to the crustaceans upon which the Japanese have based their extensive export trade in crab-meat. Lobsters (*Palinurus*), related to those which the Chileans pack in tins at Juan Fernandez, are likewise common in parts of the coast. So far as I have learned, no sea food of any kind is canned in Peru, the only familiar native marine products being dried or salted fish of many sorts, pickled anchovies, and preserved fish eggs and sea weed.

Approximately 163 marine fishes are known to science from the coastal waters of Peru. Beyond a doubt many additions will be made in future, not only through the discovery of undescribed or obscure species, but also from among widely distributed pelagic or coastal fishes, such as, for example, the *dorado* (dolphin) and the *peje-sierra* (saw-fish), both of which are apparently familiar to the native fishermen, even though no Peruvian specimens have yet fallen into the hands of a naturalist.

I kept a careful field-record of the names by

which native fishes are known to the Peruvian fishermen, for an attempt to fix these, even though the list be far from complete, will not only aid future travelers and investigators, but may also become of use in the organization of the fishing industries which are certain to be developed, sooner or later, along the coast of Peru.

Any list of characteristic Peruvian fish names lends itself to analysis into terms of three classes, as follows:

1. Old Spanish names, chiefly of Mediterranean fishes, which have been generally reapplied in Hispanic America.

2. Words of Spanish-American origin, many of which are metaphorical, *e. g.*, "*cruz*" (cross) for the hammerhead shark, "*ojo de uva*" (grape-eye) for a sea bass, "*pintadilla*" (painted) for a finger fish. In other instances the significance of the name is fanciful or entirely obscure, *e. g.*, "*ayanque*" (jackstay), for a croaker, a term which may, however, be a corruption of "*arenque*" (herring). This group includes many names which have spread to the coast of Peru from the Antilles, particularly from Cuba. Among these are "*pámpano*" and "*jerguilla*."

3. Ancient Peruvian names of the Quichua and other Indian tongues, such as "*curaca*," the title of an Inca chief. Doubtless many terms of which I have been unable to determine the source and primary meaning belong in this category.

In accordance with the genius of the Spanish language, diminutive forms are much in evidence. Such names may have come to replace the nouns from which they were originally derived, as "*mojarilla*," "*chabelico*"; or they may refer to small-sized fish of familiar species. Examples of diminutives applied in the latter sense are, "*ayanquito*," "*jurelcito*," "*lisita*," "*camotilla*," "*robalito*," "*cochinillo*."

The Old-World Spanish names, mentioned in the first group above, are worthy of separate citation, for most of them refer to Peruvian representatives of types of fishes common in the Mediterranean or in the streams and lakes of Spain. These alone are listed below; purely local names, as well as universal Spanish group names, are omitted.

<i>Spanish name</i>	<i>Literal or primary meaning</i>	<i>English vernacular equivalent</i>
aguja	needle	barracudas, needlefish and pipefish
albacora	albacore	albacore or tunny
angelote	figure of an angel	angel-fish (<i>Squatina</i>)
anguila	eel	eel
bagre	catfish	catfish
barbudo	bearded	threadfin
bonito	pretty	bonito
caballa	mare	mackerel
cabrilla	kid	sea-bass

<i>Spanish name</i>	<i>Literal or primary meaning</i>	<i>English vernacular equivalent</i>
cazon	chaser, hunter	shark
cochino	pig	trigger-fish
corvina	resembling a crow	corbina
dorado	gilded	dolphin (<i>Coryphæna</i>)
jurel	scad	scad
lenguado	tongue-shaped	flounder
lisa	mullet	mullet
marrajo	malicious	some species of large shark
mojarilla	little mojarra	a kind of croaker (<i>Stellifer</i>)
morena	moray	moray
peje-espada	swordfish	swordfish
pejerrey	kingfish	silverside (<i>Atherinidæ</i>)
pejsapo	toadfish	clingfish
raya	ray	ray or skate
robalo	robalo	a species of croaker (<i>Sciaena starksi</i>); not the robalo of the Spanish Main (<i>Centropomus</i>)
roncador	snorer	one of the grunt family (<i>Brachydeuterus leuciscus</i>)
sardina	sardine	a kind of herring (<i>Sardinella</i>)

<i>Spanish name</i>	<i>Literal or primary meaning</i>	<i>English vernacular equivalent</i>
sargo	sea-bream	used in Peru for a fish of the grunt family (<i>Anisotremus scapularis</i>)
sierra	saw	sierra (<i>Scomberomorus</i>); saw-fish (<i>Pristis</i>)
tollo	tope, dogfish	dogfish
volador	a flyer	flying fish

Although the entire Peruvian coast lies well within the tropics, its shore fish fauna is in general of subtropical or temperate, rather than equatorial, character. The reason is, of course, to be sought in the conditions of oceanic circulation. Peruvian fishes are, in a zoogeographic sense, comparable with Mediterranean fishes rather than with those of the Atlantic coast of America. In both Peru and the Mediterranean region we find an admixture of tropical species with others which are distinctly temperate or even northern, such as the *jurel* or scad (*Trachurus*). The closest faunal affinities of the Peruvian fishes are with those of the Californian littoral, which lies just outside the tropics in the northern hemisphere. Many species are common to both of these widely separated areas.

If we group the Peruvian fishes according to their habits, rather than their zoological relationships, we find aggregations of species adapted to

all types of environment that exist along the coast. Thus there are (1) many kinds of rockpool fishes; (2) numerous species specialized for life on rocky bottoms of greater depth, and (3) others, like the flounders and some of the rays, which are particularly characteristic of sandy bottoms and shallow water; (4) schooling, surface-feeding forms, like the herrings and anchovetas, are impressively abundant, while these are pursued by a great variety of (5) larger predaceous fishes, among which are the mackerels, carangids, barracudas, and the free-swimming types of sharks. Only anadromous fishes, like the alewives and salmon of North America, are unrepresented in the Peruvian assemblage.

A brief consideration of a few of the more important Peruvian marine fishes, group by group, may prove of interest.

1. *Sharklike Fishes.* These include a score of species of dogfish, sharks, angel-fish, skates, rays, and chimæras or ratfish. Certain representatives of these families are common in all parts of the coast, but it is in the north, near the point at which the Humboldt Current mingles with warmer, equatorial waters, that the sharks, guitaras, and rays are found in greatest numbers. At Lobos de Tierra and Lobos de Afuera an important fishery is carried on by the northern maritime Indians, both the rays and the sharks, including

hammerheads and other species up to seven or eight feet in length, being prepared as dried or salted products. So far as I learned, the valuable liver oil yielded by many of these fishes is seldom utilized. Neither are the hides saved, although, as has been recently demonstrated in the United States, they can be converted into leather.

2. *Herrings*. Of the three Peruvian species of herrings, the best known are the *sardina* (*Sardinella sagax*) and the *machete* (*Potamalosa notacanthoides*). Both of these migrate in enormous schools which sometimes fill the bays, supplying sustenance to larger fishes of more value to man, as well as to pelicans and certain other sea birds, and to the sea lions. On the calm morning of November 14, I crossed Pisco Bay when the shining surface, ruffled only by an occasional puff of wind, enabled me to obtain a clear view of such multitudes of herrings as I had never previously beheld. At one time I counted thirty distinct schools of *sardinas* within a quarter of a mile of my launch. They caused patches of the smooth water to break into ripples just as our North Atlantic menhaden do, and they left in their wake an oily surface covered with bubbles.

It seems probable that a Peruvian *sardina* fishery, conducted in the manner of the menhaden fishery, would prove profitable. The relative oil yield of the *sardinas*, as compared with menhaden,



Motion picture film.

FISHING SETTLEMENT OF LOBOS DE TIERRA.

The fish suspended from the bamboo poles are small sharks of several species.

has not been determined, but it is altogether likely that several marketable products, including "kippered herring," oil, "fish guano," and an ingredient of cattle and poultry food could be derived from them. For the use last suggested, the dried fish-scrap might be combined with cotton-seed waste, of which there is always an unutilized surplus in the country.

3. *Anchovies*. This family is dominated by the *anchoveta* (*Engraulis ringens*), a fish not exceeding six inches in length, the most abundant and important fish of the entire Peruvian littoral, the mainstay of the guano industry, and a food fish of high rank. Like the sardina, the anchovy subsists upon minute forms of plant life, such as diatoms and other algæ, and possibly upon small pelagic crustaceans. The fishes travel in schools of incredible size, the immature examples being sometimes visible as red dots among the massed adults. They are followed incessantly by larger fishes, sea lions, and birds of very many species. Numerous references in earlier parts of my narrative have touched upon the myriad numbers of the anchovies which, at least when conditions in the Humboldt Current are favorable, are likely to be found at any point along the entire Peruvian coast-line.

During the afternoon of February 2, 1920, while on board a steamer off Huarney, I estimated that a hundred shoals of these fishes were within sight.

At times, when the bonitos attacked them from beneath, large areas of the surface would be so broken by the leaping of the little fishes that the ocean hissed as though a deluge of rain were descending upon it. The most remarkable sight of all was the manner in which whole herds of lobos were lolling and frolicking among them, gorging themselves to the limit of their capacity.

On other occasions I have had the good fortune to run directly over schools of anchovies in a launch of shallow draft. Their appearance from above is amazing, for the quivering, silvery creatures seem to be packed together like sardines in a tin, except that their heads point all in one direction as their legion, which somehow seems more like an individual organism than a conglomeration of millions, streams through the gantlet of its diverse and ubiquitous enemies.

The abundance of the anchovies is indicated also in other ways, for it has been conservatively estimated that *thousands of tons of these fishes per day are devoured* by sea birds which breed on the Peruvian islands.

The anchovies have from early times been crudely preserved in Peru by mixing them with salt earth. Sacks of this dried product find their way far into the interior. The anchovy would make a tinned product of excellent quality, but since the species is the principal food of the guano birds, the question of granting a concession for an organized

fishery would need thorough investigation. It is probable, however, that it occurs in great excess of the needs of the birds, across the entire width of the Humboldt Current; in any case, an almost unlimited modern purse-net fishery would be less disastrous for the species than the present practice of dynamiting.

4. *Flying Fishes*. These fishes, which are characteristic of the warmer pelagic waters, well off shore, come into the Humboldt Current, along with dolphins and other tropical species, during the southern spring and summer (November to February). I obtained a large example at the Chincha Islands.

The flying fish are not in themselves important food fishes in Peru, but their egg-masses are dried to form a product known as *cau-cau*.

5. *Silversides* (Atherinidæ). Of this widely distributed family, the small marine pejerrey (*Basilichthys affinis*), which, like the anchovy, occurs in great schools, is probably the most delicious eating of all Peruvian fishes.

6. *Mulletts*. The *lisa* (*Mugil cephalus*) is a prized and abundant fish. Mulletts of this and related species are often stranded in great numbers upon the mud flats of such inlets as Independencia and Paracas Bays.

7. *Mackerels*. The representatives of this family include two very important fishes, the *caballa* or common mackerel of the country (*Scomber japonicus*), and the bonito (*Sarda chilensis*). The latter, because of its abundance and cheapness, constitutes the foremost item of marine food among the poorer people of the whole coastal region. The *caballa* also supports a considerable fishery, being taken chiefly on hand lines. Quantities are salted at the Lobos Islands and elsewhere. The *caballa* is a fish of fine flavor, and its relatively low repute in Peru is doubtless due to the fact that broiling is an almost unknown or unpractised method of cooking fish. Prepared in any other way, the flesh of the *caballa* is too oily to vie with that of species more favored by the Peruvians.

A local fishery for the *peje-espada*, or swordfish, which is a relative of the mackerels, is conducted from the port of Mollendo.

8. *Carangids*. A well represented family of which the *cojinova* (*Neptomenus crassus*), the *jurel* or scad (*Trachurus*), and the far-famed pámpano (*Trachinotus paloma*) are the most important Peruvian members.

9. *Sea Basses*. A family of many species, of which a number, such as the *cherlo* (*Acanthistius*), the *ojo de uva* (*Hemilutjanus*), the *cabrilla* (*Paralabrax*), and the several species of fishes known as

cabinsas, are familiar even though not highly regarded food fishes.

10. *Croakers and Drums*. Another well represented group, with two or more species related to our North American squeteague or weakfish, together with two of the finest fishes of Peru, the *corvina* (*Sciaena gilberti*) and the *robalo* (*Sciaena starksii*). Both of the latter attain large size, sometimes weighing forty pounds, and both fetch a high price in the markets. During my visit at the Guañape Islands, in January, 1920, many *corvinas* and *robalos* were being taken about the mouth of a river on the opposite mainland shore. Coker observes that these fishes always congregate at the outlets of the Peruvian rivers in times of flood, for the purpose of feeding upon small crustaceans which find their way from the fresh water into the sea.

11. *Flounders*. Flounders and their relatives are common and of good quality.

12. *Blennies*. The several kinds are plentiful, occurring everywhere about the islands and along rocky shores. Perhaps because of their abundance and grotesque appearance, and the fact that they are often a nuisance to fishermen, the blennies figure more or less in folk-lore of the Peruvian coast. Thus two or three species are known as *borracho*, which means drunk. Fishermen at several

places told me that eating the *borrachos* would produce intoxication or stupefaction. At the Chinchas I heard one species of *borracho* called also *sueño* (dream), the implication of which is no doubt similar.

13. *Cusk Eels*. The family of the *cóngrío* (*Genypterus*), an abundant and highly prized food fish, especially in the southerly parts of the coast. The *cóngrío* is sometimes known as the *bacalao del país*, "native cod," for it furnishes a desiccated food of first rank. The principal *cóngrío* fishery is in the vicinity of Mollendo, where the fishes are taken on trawl lines. Their reputation, however, extends to all parts of Peru.

Many *cóngríos* were caught by the guardians of North Chincha during my stay. The lines were set on dark nights, the legend that these fish would not take hooks in the moonlight evidently being fully credited. Excellent catches were made and I was able to observe the native method of preparing the famous *charquecito*. The fresh fish were split down the back, and, after cleaning, were soaked in the cool sea water for twenty-four hours or longer, until the blood had diffused out. Finally they were hung in the air, without salting, until the white flesh had thoroughly dried.

The opportunity for more efficient and extensive fisheries operations in Peru has occurred to many

persons and has, indeed, been tried, although thus far without success. More than a century ago Joseph Skinner wrote:

The fishery is a branch of industry exclusively belonging to the Indians situated on the coast; but they are destitute of skill, and, being at the same time unprovided with proper boats and fit instruments, keep constantly within sight of the coast, venturing but a very small distance to sea. Hence arise the scarcity and dearth of fish, so often experienced at Lima, and in all the places along the coast. A few years ago several boats of a particular construction were built for the purpose of fishing throughout the whole extent of these seas; but this scheme was shortly afterwards abandoned.

Not many years ago, a trawling venture was undertaken, the Scotch steamer 'Alcatraz,' which subsequently passed into the hands of the guano administration, being employed with modern equipment for some months. The bottom proved rocky in most places, and hence not satisfactory for this type of fishing, but fish were nevertheless taken in abundance. The problem of a sufficient market, however, ultimately led to failure, for, when the seaports had been glutted with fish, means were lacking for transporting the catch to centers where it would have been in demand.

Beyond doubt organized fishing in Peru will eventually be conducted with success. The resources are great and varied; the bays or protected

roadsteads of Independencia, Chilca, Paracas, Pisco, Callao, Ancon, Huarmey, Samanco, Ferrol and others offer inviting sites for stations; native fuel oil is obtainable in quantity; adaptable labor is already on the ground; the climatic conditions of the coastal ocean are almost without parallel; the government is eager to see the country's natural resources developed. A rich potential market exists along both coasts of South America and in the interior, besides which it is likely that many prepared products might profitably be exported to the Orient and even to the northern hemisphere.

CHAPTER XII

CREATURES OF THE SEA-SURFACE, THE AIR, AND THE ISLES

THE overwhelming majority of living things on the seacoast of Peru belong to the fauna of the ocean. For the most part they are invisible to the eyes of travelers, who see only a reflection of the submarine riches in the incredible flocks of birds and the schools of porpoises and seals. But these are an ever-present fascination, and, however great the numbers of individual animals, the variety of species is so relatively small that anyone having the slightest knowledge of natural history may aspire to recognize and name most of the birds, beasts, and even the lesser folk that come within his ken.

The purpose of this chapter is to tabulate briefly the visible life of the coast, afloat and ashore; to tell of some of the associations formed between warm-blooded animals and more humble beings in the intricate web of nature; to describe at least the conspicuous creatures so that they may be linked up with their scientific and native names; and, finally,

to point out a geographic significance by distinguishing those which are peculiar to the field of the Humboldt Current from others which, like human tourists, use the placid coast as a seasonal resort, and thus escape the rigors of the Far North or the Far South.

The terrestrial life of the forty or more groups of Peruvian islets is naturally very limited owing to the arid climate and the consequent paucity of vegetation. The three lofty islands—Vieja, San Gallan, and San Lorenzo—whose summits penetrate the cloud zone, support a small assemblage of flowering plants; the others are plantless, excepting only Lobos de Tierra which lies near the region of equatorial rains and has two kinds of plants.

Birds, of course, make up everywhere the outstanding element of the insular life. Of reptiles, there are but two or three sorts of lizards. The mammals, disregarding sea lions and otters whose affinities are marine, comprise introduced rats (*Rattus rattus alexandrinus*), and vampire bats, of which I collected a single species (*Desmodus rotundus*) at Vieja, Chinchá, and Asia islands. To these should be added a wild dog, which apparently occurs upon lofty San Gallan. This carnivore seems to be still unknown to science, but it is doubtless related to a species called *Cerdocyon sechuræ*, inhabiting the more northerly mainland desert.

The lower land-living creatures of the islands are few, when contrasted with the profuse invertebrate

life of the surrounding waters, but they are of much interest because of their amazing abundance and the peculiar geographic relationships of some of them. All the strictly terrestrial invertebrates which I observed were either arachnids (spiders and their allies), insects, or mollusks, and a considerable proportion of them proved to be hitherto unknown species.

To begin with the spiderlike forms, the guano islands have a plentiful population of scorpions, false-spiders (*Solpugida*), spiders and ticks, of which all but the first may be safely handled. A pale yellow scorpion (*Hadruioides lunatus*), which ranges from Chile northward through Peru to Ecuador and the Galápagos, is found upon most if not all of the islands, for I collected examples at many points between the Chinchas and Lobos de Tierra. A small islet off the Morro of Arica is, indeed, called "Alecrán," the Hispanic-American name of the scorpion.

At the Chinchas the *alecranes* can be readily found beneath the dead bodies of birds. Since they do not feed upon carcasses, they probably choose these unpleasant hiding places in order to escape the light and to prey upon flesh-eating insects, such as the larvæ of carrion beetles. The scorpions are nocturnal, leaving their retreats at twilight to go a-hunting. They devour spiders, as well as insects, seizing their victims with the crablike pincers and killing them, if necessary, with the red hot needle

in the tail. The Indians do not hesitate to pick up the scorpions, grasping them deftly by the up-turned dangerous end.

The solpugids, or false-spiders, are pot-bellied little monsters, the nearest approach in appearance to what might be called a land octopus. They are related to both scorpions and spiders and share some of the characters of each. At the Chinchas I collected a very distinct new form, which Dr. Ralph Chamberlin of Harvard has named *Chinchipus peruvianus*. Strangely enough, it appears to be most closely related to a group which lives in the deserts of Egypt and Palestine.

The false-spiders are, like scorpions, nocturnal and shy. They are very active, feeding mainly upon flies and other winged insects. They can be easily attracted by a lantern, in the flickering light of which their alternately stealthy and dashing movements, as they stalk and pounce upon their prey, can be well observed.

Arañas or ground spiders live in astounding abundance on nearly all of the Peruvian islands, making innumerable silk-lined tunnels in the guano and the stony soil. At South Chincha and elsewhere I saw areas in which each square yard of the surface was dotted with scores of spider burrows. Only in places actually occupied by dense colonies of guanayes or other birds are the spiders temporarily driven out by the rapid accumulation of guano and the trampling of webbed feet.

The most significant fact concerning the ground spiders is that they appear to subsist largely upon the native ticks, which are blood-sucking parasites of the birds. The spiders' dens are sometimes filled with shriveled remains of the ticks, for, since spiders eat only the body juices of their quarry, they take a remarkably heavy toll. Thus they become the chief natural agency in restricting the numbers of an important enemy of the guano birds.

The insular ground spiders are related to Peruvian continental forms, but are distinct species. Specimens from the Chinchas and from Lobos de Tierra proved to be undescribed, and have been named, respectively, *Dysdera murphyi* and *Loxosceles nesophila*.

Ordinary web-spinning spiders are probably not native to the guano islands, but have been introduced since the erection of houses and sheds. A species which made the most of a rich supply of house flies in the guano administration buildings at the Chinchas evidently came from an unknown source, for it, too, turns out to be a new species which Dr. Chamberlin has called *Tetragnatha aptans*.

Finally, an extraordinary jumping spider, described from my specimens as *Sitticus mazorcaus*, lives on Mazorca. It is the first of its genus known from South America. The fact that it progresses by leaping, instead of by crawling or running,

makes it conspicuous on the guano-whitened slopes of the island.

Bird-infesting ticks, which resemble nothing more than tiny balls of guano, are extremely numerous at all of the islands, living in the guano and the crumbly rock and feeding parasitically upon blood. Examples taken from the soil and from the plumage of a camanay at Lobos de Tierra belong to a species called *Ornithodoros tulaje*. The tick of the Chincha Islands is distinct, and has been named *Ornithodoros amblus*.

Although these creatures are close kin to an African species which carries the blood organism of relapsing fever, there is no evidence that the Peruvian ticks are responsible for epidemic disease among the guano birds. Beyond doubt, however, they draw off seas of blood, and if it were not for the beneficent appetites of the ground spiders they might become a serious menace. Moreover, the ticks do not confine their attacks to the birds, but at times bite the skin of the native Indian laborers, usually upon the feet or legs, producing sores which are apt to be persistently troublesome.

The adult ticks, which attain a length of little more than a quarter of an inch, are known to the Peruvians as *garrapatas*, while the larvæ or seed-ticks are called *chuychuyes*. Ticks in the latter stage of growth were seen in great swarms on the ground of several islands as well as among the feathers of penguins, boobies and other birds.

Ticks of the family to which the guano island species belong have much the habits of bed-bugs, feeding voraciously for short periods at night, and then leaving their hosts. Only the female ticks become distended into turgid bags of blood. After being fertilized, they drop to the ground to lay their eggs, and then, having no further impulse or duty in life, they die. The eggs are very numerous; as many as twenty thousand have been counted in single deposits of certain species. They hatch within a few days, and the microscopic *chuychuyes* soon crawl up the legs of the ubiquitous birds. Temporary absence of birds would not involve the extermination of the larval ticks, for they are capable of living months, or even years, without food. Whenever they achieve contact with a suitable host, they work their way through the feathers, bury their mouth-parts, and suck blood. Before the metamorphosis which changes them from *chuychuyes* to *garrapatas*—and from six-legged to eight-legged creatures!—and also before each moult of their outgrown leathery skin, they drop to the ground, renewing their attack later.

The ticks quickly desert the body of a dead bird, probably because of the coagulation of the blood rather than the reduction of temperature. Related species of ticks live upon turtles, lizards, and snakes, as well as upon warm-blooded animals, but the lizards of the Peruvian islands are apparently not infested.

The lizards, by the way, are excellent entomological collectors. I am indebted to them for much that I learned about the island insects, for an examination of their stomachs brought to light a greater variety of flies and beetles than I succeeded in capturing in the open.

Most of the insular insects are, of course, forms which feed upon animal matter. Butterflies and moths are, however, sometimes blown across from the mainland, while these, as well as crickets and others which are mainly vegetarians, are indigenous on the three high islands which support plants. A cricket (*Sphingonotus*) of San Gallan seems to be the same as a species inhabiting the Galápagos Islands.

Carrion beetles (*Dermestes peruvianus* and *Dermestes vulpinus*) are the sextons of the islands. They begin their work where the vultures have finished, and can always be found in the drying carcasses of birds, seals, fish, and sea turtles. No doubt they fulfil a very useful purpose, but I came to regard them as pests because they were forever working their way into my zoological specimens.

The other beetles which I encountered were all tenebrionids, or "darkling" beetles, a family well represented in desert regions generally. Most interesting among these are the large *capachitos* or *abuelitos* of the genus *Psammotichus*, a group peculiar to South America, although bearing the

name of a ruler of ancient Egypt. One form (*Psammetichus costatus*) was obtained at the Guañape Isles and at Lobos de Tierra, and a new species (*Psammetichus lavalleyi*) at Asia Island. Still another darkling beetle, of the genus *Blapstinus*, occurs at Lobos de Tierra. All of these *capachitos*, as the guano workmen term them, appear to feed upon animal refuse.

The only moths identified belong to the genus *Agrotis*, which is almost cosmopolitan. Since the caterpillars or cut-worms require grasses, it is certain that the moths seen on the plantless islands had been transported by the wind from the continent. Native species probably exist, however, on San Gallan, Vieja, and San Lorenzo.

Of other aerial insects, robber-flies (*Cyrtopogon*) are conspicuous. These are insect hawks, which capture less predaceous insects in mid-air, hold them in their legs, puncture the body wall with their beaks and suck out the soft parts, leaving only an empty shell.

Flesh-flies (*Sarconesia chlorogaster* and a species of *Sarcophaga*) share carrion with vultures and with some of the beetles. They were especially common during my visit at the Chinchas, as was also the cosmopolitan house-fly (*Musca domestica*), which occasionally appears at the islands in such swarms that it constitutes a veritable plague.

Another widely distributed tropical fly (*Synthesiomyia brasiliensis*) found at the Chinchas may

breed in masses of decaying sea weed in the grottoes.

The curious flattened, triangular, louselike hippoboscids, or feather flies, which scuttle about with the gait of crabs, are the most familiar of insects upon all the bird islands. They are known to the guano workers as *moscas de gallinazo* (vulture flies), but my collections show that the species (*Pseudofiersia vulturis*) which lives in the plumage of the turkey vultures is distinct from the parasite (*Pseudofiersia maculata*) of the Peruvian cormorants, gannets, pelicans, and gulls. The latter fly has been found also in North America on the loon and the fish-hawk. It is rather suggestive, with reference to the insect's distribution, that the fish-hawk makes a regular winter migration to Peru.

The feather flies are enormously abundant; sometimes a dozen together can be seen sidling about the plumage of a nesting guano bird, and slipping in and out between the feathers in an uncanny way. On one December afternoon an inconceivable number covered the soil on the leeward slope of Mazonca Island. Practically no breeding birds occupied this side of the island, but there were colonies of both guanayes and piqueros on the windward exposure. The flies were so thick that hundreds dotted each square yard of ground. When I laid down my gun, it was immediately covered with the shiny, jerky creatures.

The last of the parasitic flies to be noted is an equally strange insect of a family called the Streblidæ, all the members of which live in the fur of bats. The body of the bat, swirling through the dark air by night, hanging in black caves by day, is their earth; the outside world is an unknown universe. Many examples of a minute species called *Trichobius parasiticus* were taken from a vampire at Asia Island.

Next to the hippoboscids, the crawly vermin most in evidence are the flightless Mallophaga or bird lice. These are not blood-suckers, but subsist upon the tissue of feathers, fur, and skin scales. Two kinds, *Lipeurus forficulatus* and *Tetrophthalmus titan*, inhabit the feathers of the Peruvian pelicans, cormorants, and boobies.

The last-named mallophagan is the notorious *piojo* of the guano islands. It not only occurs on the birds, but at times in great numbers on the ground. After visiting a guanay or alcatraz colony, I have sometimes found myself covered with the annoying *piojos*. Even in my motion pictures they can be seen creeping over the eggs and young of pelicans. They never pierce the skin, nor do they remain long on a strange host such as a human being. Whether or not they should be regarded as enemies of the guano producers is questionable. They are doubtless innocuous to adult birds, but I noticed that they caused an irritation on parts of the skin of naked nestlings. Moreover, they attach

themselves in clusters inside the pouches of pelicans, where they must lead a more or less amphibious existence.

The only land mollusks of the Peruvian islands are delicate snails (*caracoles*) which dwell in the high plant zones of the three mountains-in-the-sea. Dr. Coker suggests that they may have been originally introduced from the Andes on the feet of condors. The snail of San Gallan (*Bulimulus hennahi*) is known also from the headlands of Tacna. The species of Vieja Island (*Bulimulus cokerianus*) inhabits similar cloud-enveloped peaks, where it feeds upon the foliage of mallows and other flowering plants.

Turning now to the reptilian life of the Peruvian coast, *tortugas* or sea turtles are not uncommon along all shores. The only species which I identified is the delectable green turtle (*Chelonia agassizi*), but it is likely that a hawksbill and others also occur. The projecting heads of large green turtles could be seen at almost any time in January from the beaches of Lobos de Tierra, but the Indians made no organized attempt to take them. A *tortuga* fishery is from time to time conducted from Pisco, however, as well as from a cove at the northern end of Independencia Bay.

Although turtles freely enter the cool, inshore waters of the Humboldt Current, it is notable that they do not deposit their eggs anywhere within the boundaries of Peru. The breeding range seems to

be determined largely by ocean temperature, and, in accordance with the conditions described in Chapter IX, it is confined on the Pacific side of the continents to the shoreline between the Gulf of Guayaquil and the Gulf of California. On the Atlantic coast, where the Gulf Stream and the Brazil Current tend to spread out the tropical waters, the breeding grounds extend from Virginia to southern Brazil or beyond. The reproductive range of the turtles agrees, indeed, very closely with the distribution of coral reefs. In the Pacific these are limited to a narrow belt between 4° and 21° of north latitude, being entirely lacking along the Peruvian coast. But on the Atlantic side the reef-building corals thrive between 22° south latitude and 34° north latitude, the northernmost reef in the world lying off Beaufort, North Carolina.

The land reptiles of the Peruvian islands comprise only small lizards which, strangely enough, are very abundant at some islands and totally absent from others. It is hard to explain why the Pescadores and Mazorca, for example, should have not a sign of a lizard, when the Chinchas, Asia, and Lobos islands fairly teem with them.

Two types are found, the first known as *lagartijas* (genus *Tropidurus*), and the second as *saltojos*, *salamanquesas*, or *calatillas* (genus *Phyllodactylus*). The *lagartijas* are diurnal and conspicuous; the *saltojos* or geckos are small, secre-

tive night-prowlers. Slightly distinct forms of each kind possibly occupy the different islands, but, as my specimens have not yet been critically studied, they cannot be named with technical precision.

The *lagartijas* wander with impunity among the nests of the guano birds; they scamper in and out of the burrows of petrels and Inca terns; they walk like flies along the faces of vertical cliffs; in short, they overrun the islands from the weed-grown rocks at tide line to the misty crags thirteen hundred feet above sea level. So far as one can judge, they are without enemies, unless the foraging sparrow hawks from the mainland occasionally capture them.

The *lagartijas* reach a length of a foot or a little more. Whenever they cease from scurrying about, they make themselves appear ridiculous by rocking up and down on their front legs. The black-throated males especially are always at this performance, varying it with quarrelsome or love-making antics when they meet their fellows. Two males, for instance, will spring toward each other with jaws agape, but, instead of coming to grips, they will go waltzing round and round as if they were on opposite ends of a spinning stick.

In the guano administration buildings the *lagartijas* become almost domesticated. Nobody disturbs them, and they have the run of the house. I have seen them pick insects out of the air by leaping up from the threshold, and I counted more than



A LIZARD OF THE CHINCAS.



SEA LIONS ON THE ROCKS OF LOBOS DE TIERRA.
In the right foreground are fledgling guanays.

a hundred house flies in the digestive tract of a small lizard killed at the Chinchas.

The *saltojos*, which bear the altogether unjust reputation of being venomous, are clinging, sticky-footed, weird little dragons, most easily discovered by standing a lantern on the ground at night. When insects gather around the light, the tiny, golden-eyed geckos come skulking after them. Although they belong to a family of "singing lizards," I never heard the voice of the Peruvian species.

The two or three land mammals of the islands have already been mentioned. All the others belong to the sea, and comprise whales, porpoises, seals, and an otter. The cetaceans doubtless number many sorts, but they have been investigated so little that they cannot yet be catalogued. Beaked dolphins frequently observed in the surf close to shore resemble a common form (*Delphinus delphis*) of the North Atlantic. The handsome, black and white, beakless porpoises which played beneath the stem of the 'Alcatraz' during the trip toward Huacho, probably belonged to a species called *Cephalorhynchus albifrons*. Among the jetsam of the dry lagoon of Independencia Bay I picked up a skull of the rare but widely distributed pygmy sperm whale (*Kogia breviceps*), not previously reported from South America. Porpoises in general are known to the Peruvian fishermen by the names *delfin*, and *bufeo* (puffer).

The status of the larger whales has been learned no more satisfactorily than that of the porpoises, but cruising grounds "on Peru" were famous resorts of the American sperm whalers during a century of the chase. As the old Yankee song has it,

Come, all ye brave sailors who are cruising for sparm,
Come, all ye bold whalemens who sail round the Horn,
Our skipper has told us, and I hope it proves true,
There's plenty more whales on the coast of Peru!

In recent years a native whale fishery has been conducted from Tumbes, at the northern end of the Peruvian desert.

The whale most frequently seen in inshore waters of the Humboldt Current is the humpback (*Megaptera nodosa*). This is a long-flipped whale-bone whale, of totally different appearance from the sperm whale (*Physeter catodon*). Unfortunately, whales seldom reveal themselves clearly to passengers on steamships, but the spouts of the sperm and the humpback are sufficient to disclose their identity at long range. The jet of vapor from the sperm whale's nostril is prolonged and slanting, projecting forward at an angle from the tip of the blunt snout. The spout of the humpback, on the other hand, is an explosive, bushy puff, thrown straight into the air from blowholes on top of the animal's head. Finback whales (*Balaenoptera*) are, perhaps, less common, although I saw at least

one good-sized herd. Their breathing is equally diagnostic, for they send forth slender fountains two or three times the apparent height of the hump-back's spout.

The *lobo de mar* (sea wolf), or sea lion, is the dominant marine mammal of the Peruvian coast. As noted elsewhere this species (*Otaria byronia*) is quite unlike the sea lion of California. It is typically a seal of cold, southern waters, but the influence of the Humboldt Current makes Point Pariña (lat. 4° 45' S.) as congenial to it as Cape Horn.

George Washington Peck, whose vivid tale of the Chincha Islands in 1853 is quoted in Chapter V, has left also an entertaining account of the lobos. Without wholly sympathizing with his subjective and somewhat phantasmagoric pen picture, I can, nevertheless, heartily commend his keenness of observation.

But the sea lions, the hereditary lords of the islands, are as strange and remarkable as the grottoes. They are almost always swimming and blowing about among the shipping, and one soon gets tired of watching their movements. They may be seen in pairs and parties of all numbers up to twenty or thirty—rarely alone. They cruise leisurely around, swimming just under the surface, sticking their noses out and taking breath at regular intervals; sometimes they do this as often as once in ten seconds, coming up as they swim, about once in a ship's length for several minutes in succession. This appears

to be when they are "prospecting," as the miners would say, for a school of mackerel or herring. When they have gone on for a considerable distance in this way, either making a straight wake or winding about, they will sound and be gone much longer. In doing this they always turn on their sides and go down a back summerset like the pelicans in the air. I have seen them do this almost under the ship's stern within a few yards distance, in a calm forenoon when the water was like glass. Looking directly down upon them they use their flippers so like arms that they seem like devils in half human forms. I remember it made me shudder to see them turn and plunge directly down in the clear water, with such swiftness that in a second their forms were lost in the depth and darkness.

But of all created things and monsters in the world, I think there can be none that when seen near at hand wears so horrible a face and shape. Their mouths, with their enormous tusks or fangs, and cat-like whiskers, resemble somewhat the mouths of lions; their nostrils or blow-holes are very large and they have great saucer-like eyes and no ears. To see them come up half out of water near a boat is positively awful to behold, and enough to shake any unaccustomed nerves. We chased a party of them one afternoon and tried to head them off and throw a lance into one, but they took good care to keep just out of reach. They were fishing, and several times they came up with mackerel in their teeth very near us. I never saw or dreamed of anything more horrid to look at. Their eyes are probably adapted to seeing at many fathoms depth, and from their staring I suspect they do not see well in the sunlight above. Nothing can be conceived more unnaturally hideous. They are the em-

bodiment of despair. Along with the look of fierceness and cruelty, they have one of agony and suffering that makes them altogether appear to be the compelled agents of some diabolical spell or inevitable doom, like the wicked afrites and genies of the Arabian Nights.

Everything about them is mysterious. Half beast and half fish preying under water, living in darkness, and permitting themselves to be seen only partially, at brief intervals, and in shapes of such fearful ugliness—I could never wholly divest myself of the idea that they were animated by fiendish intelligence—that they were either possessed by devils or lost souls imprisoned in and made subject to the appetites of the most repulsive and voracious bodies.

Their breathing is always like sobbing; their cries are wails; who knows what they could reveal if they could speak? The depths of the sea and the monstrous creatures that inhabit there are familiar to them, and so are the darkest recesses of the great caverns. They were created to be Destroyers. There is no doubt that to support their lives they must devour an incredible number of the small fishes. They may be seen for hours daily, chasing herring and mackerel and evidently havocking among them right and left. When they are surfeited they retire to their caverns and lie stupidly on the slippery rocks till hunger drives them out to forage again.

The wild, human yelling of the lobos is, indeed, eerie, especially when a gaping cave forms a sounding chamber for their clamor. Their ineffective sense of sight is also borne out by my notes. They are as blind as the proverbial bat. I have stood

quietly on spray-washed rocks at the Chinchas, where the sea lions have through bitter experience become shy, and have watched a big retroussé-nosed bull come ashore within range of a tossed stone. He may have seen me dimly, but one would judge that his nose was more trustworthy than his eye, for he kept pointing the former in my direction, sniffing suspiciously. Sea mammals are not usually credited with keen scent, yet I always found it difficult to stalk the lobos down the wind, even when I was completely hidden by rocks. You may pass them closely enough on the lee side, but as soon as you come to windward they scramble for the water, where they ride the swells, shoulders out, and blink toward shore.

On the low rocky promontories they rest for hours, the bulls appearing to balance their huge heads and necks by sticking the snubby snouts straight into the air. This pose gives them the same vacant, star-gazing expression as that worn by Tenniel's fish-footman in 'Alice in Wonderland.' Now and then they stir to scratch away their small troubles, or they may even indulge in combat with a comrade seeking to land at a pre-occupied spot, but otherwise they scarcely budge between dawn and sunset.

The lobos have been charged in Peru with destroying young guano birds when the latter first take to the water. If true, however, such attacks must be very rare. The birds pay little attention

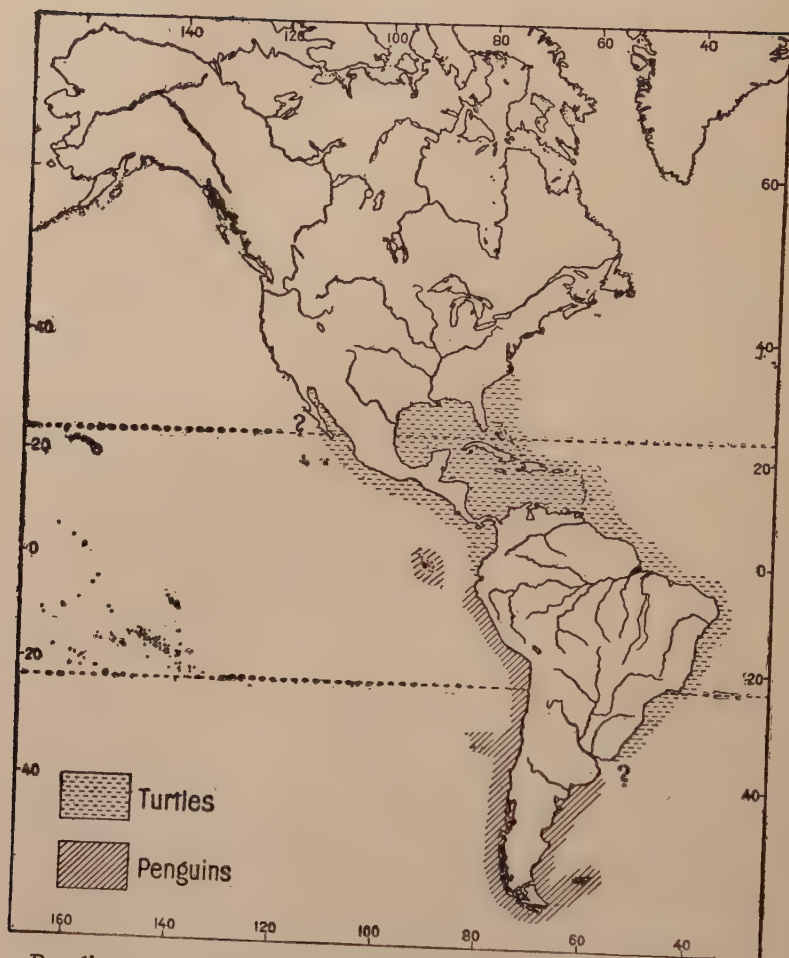
to them, although gulls and terns sometimes move a few feet when a lobo swims too near. So far as my experience goes, the sea lion's food is typified by the stomach contents of a five-foot female shot at the Chincha Islands in October. This was as follows:

- 17 *sardinas* or herrings (*Sardinella sagax*).
- 2 *caballas* or mackerels (*Scomber japonicus*).
- 2 *cojinovas* or rudderfish (*Neptomenus crassus*).
- 1 *jurel* or scad (*Trachurus murphyi*).
- 3 half digested fishes, probably of one or more of the species listed.
- 3 roundish stones about 1½ inches in diameter.

The fishes were of an average length of nine inches, but I have seen lobos mouthing and tossing much larger prey, and they commonly seize and mutilate big bonitos in the nets of fishermen.

Related to the sea lion is the now all but extinct southern fur seal (*Arctocephalus australis*), known to the Peruvians as the *lobo fino* or *lobo de dos pelos* (valuable seal, or seal with two coats). A few of these still sometimes haul out on the seaward beaches of Vieja Island, where the hunters can reach them only by being lowered over the cliffs in a boatswain's chair. The sole traces of the fur seal that I found were unmistakable bones in the stomach of a condor killed at San Gallan.

This fur seal formerly lived along the coast from Cape Horn to northern Peru and the Galápagos, throughout the path of the Humboldt Current.



Breeding ranges of penguins and sea turtles, the former determined by low, the latter by high ocean temperatures.



Ranges of fur seals: the northern genus, *Callorhinus*; the southern genus, *Arctocephalus*. It is noteworthy that no fur seals occur in the warm water littoral between northern Peru and Lower California.

The genus, moreover, has succeeded in "jumping" the northern oceanic barrier of warm water, for a related species is resident off the coast of Lower California. The latter range, it should be observed, is well north of the zone of tropical ocean water, in which, of course, no fur seal is found.

The last of the Peruvian coastal mammals which needs description is an otter (*Lutra peruviansis*). This beast has doubtless reached the ocean by way of the continental rivers, for it is not closely related to the true sea otters of the North Pacific. To islands like the Chinchas, which lie ten or more miles from shore, the otters never make their way, but at the Pescadores, San Lorenzo, Pachacamac, Asia, San Gallan, or Vieja the sleek, thick-tailed creatures may often be spied carrying a fish ashore. Their local name is *gato marino* (sea cat), and the Indians rightly credit them with being *muy sabido* (very knowing). At Independencia Bay I followed a number of the otters in a boat, but they made long dives and completely outguessed the Indian hunters. Once on the beach of San Gallan I had a very close view of an otter when it hung straight upright in the high breakers, treading water, while it watched me from a distance of but four or five yards.

And now for the birds, which are the real lords of the Humboldt Current, although they are dependent, as we have seen, upon a long chain of antecedent life. Their very existence ultimately

hangs, indeed, upon a delicate balance of geographic and meteorological conditions. But these have remained stable, with minor fluctuations, since the uplift of the Andes, and they are likely to endure until in some distant epoch the mighty roof-ridge of the continent has been worn down to a range of rounded hills.

An ornithologist is, perhaps, at a disadvantage in attempting to run the gamut of Peruvian littoral bird life. Only a poet, or a pioneer naturalist of bygone days, when readers were naïve and credulous, could hope to undertake it with confidence of conveying his own impressions. Sophistication doubtless sharpens the appreciation of an observer, but it is likely also to dim the color of his descriptions. A bard can write verses "To a Water Fowl" far more happily than to a red-throated loon! Nevertheless, I must pin to other chapters my hope of giving broad and appealing pictures of the wonderful Peruvian coast and its bird life, and must proceed now with my hand-list, placing special emphasis on the birds which naturalists call endemic, that is, to such as are native to these waters and to no other part of the world.

PENGUINS

The Peruvian penguin (*Spheniscus humboldti*), which can not be mistaken for any other bird, is, of course, the descendant of an immigrant from south polar seas. It is slightly different from the

penguin of southern Chile and Cape Horn, and still more so from its little brother of the equatorial Galápagos. The Peruvian species breeds all along the coast to a point about 6° south latitude where its range, like that of so many of the native sea birds, stops sharply.

The people of the coast aptly call the penguin *el pájaro niño*, the child bird, a name which fits its waddling, upright gait and ingenuous appearance. To-day it is nowhere common, but according to old records it once inhabited the islands in great numbers, riddling the vast blankets of guano with its nest burrows.

I found the homes of penguins under the bases of cliffs and in caves of the Chinchas, Ballestas, Pescadores, and other islands, but the only large communities were at Vieja, along the shore of Independencia Bay. Here the main "story" of the penguin apartments was underneath a terrace which marked a former water-line. The shelf or cut-bank was composed of a consolidated mass of small marine shells, and was twenty feet above the present level of the bay. A second stratum of shells lay at an altitude of sixty feet, and this, too, formed the roof of a number of penguin burrows. A level promenade had been worn along the face of the bluff below it, serving as a porch for all the residences, while winding pathways of the extraordinary birds led four or five hundred feet further up the steep hillside.

However bland and childish the penguins appear at a distance, they are far less ingratiating when cornered among the rocks. The naked skin of their faces becomes livid with rage, and, when escape is impossible, they fight like berserkers. All this applies to the adults; the downy chicks are gentle and trustful creatures which take well to captivity and soon become as chummy as a puppy. At the Chinchas the Indian laborers brought me a half-grown, thoroughly domesticated *pájaro niño* as a gift. I accepted it with much appreciation, and asked its name. Whether the spokesman merely wished to please me, or whether he was an admirer of the late Chief Magistrate of the United States, I do not know, but he answered without hesitation,

"Presidente Weelson! señor."

TUBINARES

The petrels, fulmars, shearwaters, and albatrosses of the coast make up a numerous assemblage. Some of them are confined entirely to the Humboldt Current, while others are migrants from tropical waters to northward or from antarctic seas.

Most notable in the first of the three groups is the short-winged, black and white *potoyunco*, or diving petrel (*Pelecanoides garnoti*), which has the whirring flight of an auklet rather than the gliding habits of its long-winged relatives. Its family,

like that of the penguin, belongs in general to the Far South; only in the Humboldt Current do diving petrels breed north of about 37° south latitude. Like the penguin, again, the *potoyuncos* have suffered great diminution in numbers with the transformation of the surface of the islands. The Peruvian naturalist, Raimondi, credits them with being highly important guano producers in former times, and George Washington Peck reports great flocks at the Chinchas in 1853. They no longer nest upon these islands because the substance into which they are capable of burrowing has been removed.

It is clear that the *potoyuncos* are not highly dependent upon the power of flight, because they moult their wing quills all together and thus for a time each year become exclusively aquatic. The stomachs of such crippled, penguin-like birds, however, are as well filled with crustaceans or little fishes as those of their flying brothers. They capture their prey by making shallow dives, remaining from three to twenty seconds beneath the surface. Since the wind and current carry them northward, most of their flying is in a southerly direction, but the only indispensable use of their undersized wings seems to be to bear them to their burrows in the hills.

At Vieja Island, between altitudes of 600 and 1000 feet, I first found their nests. The burrows were not evenly distributed, but made scattered

colonies, like the settlements of kangaroo rats or other desert rodents. They were always in soft soil, never piercing the crust of alkaline salt which formed the walls of many crests and gulches. Moreover, they were all situated on windward, that is, southerly, exposures, and wherever an east-to-west ridge cut across the island, the burrows on more northerly ridges were always enough higher to raise them out of the lee. Such choice of sites, determined by the prevailing wind, doubtless gave the *potoyuncos* an advantage in taking flight from their thresholds, a feat more difficult for them than for longer-winged petrels.

The smaller petrels, members of the group which English-speaking seafarers call Mother Carey's chickens, are known indiscriminately to the native fishermen as *danzarines*, *bailarines* (ballet-dancers), or *felices* (happy ones). Two common black, white-rumped types are Elliot's and Wilson's petrels (*Oceanites gracilis* and *O. oceanicus*). They are scarcely distinguishable in the field, but the former has a whitish belly and is a native of Peru, while the slightly larger Wilson's petrel is a resident of the antarctic on vacation.

An equally small, short-legged *danzarín* is *Oceanodroma tethys*, which has been found nesting in rocky clefts of Pescadores and San Gallan islands during May, June, and July, the winter of the southern hemisphere.

Larger than any of these are Markham's and

Hornby's petrels (*Oceanodroma markhami* and *O. hornbyi*). The former is all black, very abundant, and conspicuous because more than any other petrel it follows steamers, scouring back and forth across the wake all day long with a characteristic "leaping" flight. Hornby's petrel is fawn-colored, with a gleaming white breast and a collar around its neck. It is the most erratic, batlike flier of all the *bailarines*, and is of much ornithological distinction because until very recently it was considered one of the rarest of all birds. Ten or fifteen miles off shore the most casual traveler in Peru may, if he is lucky, see hundreds of Hornby's petrels in a day, but he should be duly impressed by the knowledge that for sixty years Admiral Hornby's single specimen in the British Museum was the only one ever seen or heard of.

It should not be concluded, therefore, that the *bailarines* are always easy to discover, for under certain weather conditions their visibility, as they flutter low over the waves, is almost nil. Many a fisherman has spent a lifetime in this very ocean without being aware of the existence of some of the fairly common kinds. When Mr. Rollo H. Beck, a veteran student of marine birds, was collecting for The American Museum of Natural History in Peru, he chartered a coasting sloop under command of an experienced native skipper and sailed several days' journey off shore. The subsequent enlightenment of the Peruvian sailors was related

to me by my friend of the Chinchas, Captain Charles Niehorster, who was a member of the crew.

One quiet gray morning early in the course of the voyage, Beck remarked that he would like to lower a boat for birds.

"But there are no birds here, señor," said the skipper, waving an arm around the circle of blank water.

Nevertheless, a skiff was sent down, and Captain Charlie manned the oars. For two miles or more he pulled straight ahead, while Beck methodically tossed flecks of oil and grease and scraps of meat in the boat's track. Then they doubled on their course, and to Charlie's amazement the long food-line was soon dotted with unfamiliar, dainty sea-sprites, which skipped and danced like butterflies along a blossoming hedge-row. A series of many kinds, including specimens of Hornby's petrel, was brought back to the sloop, and displayed before the doubting crew.

"But we have never before had such birds as these in Peru, señor," insisted the captain. And his men unanimously agreed.

Bigger than any of the *danzarines*, or about the size of a crow, are the abundant *doñas* (ladies) or *pardelas*, of which the sooty shearwater (*Puffinus griseus*) and the pink-footed shearwater (*Puffinus creatopus*) are to be seen in flocks, especially off the seaward promontories of the larger islands. The sooty shearwater, which is all dark, is the com-

moner. Both nest far south in the southern hemisphere, but both migrate northward to the west coast of the United States in our summer.

At least three other petrels are likewise called *doñas* or *doñanas*. These are all antarctic types and include the white-chinned petrel (*Procellaria æquinoctialis*), a powerful black species, as large as a herring gull, the slightly smaller, pearly gray southern fulmar (*Priocella antarctica*), and the well known Cape pigeon or pintado petrel (*Daption capense*). Related to the last two is the huge gray *pájaro carnero*, or giant fulmar (*Macronectes giganteus*), which is as big as some of the albatrosses. This bird, too, is a visitor from the Far South, but can be found at all seasons in Peruvian waters. Its Spanish name might be translated "mutton bird," the English sailor's appellation for various petrels; but *carnero* means a sepulcher as well as a sheep, and I suspect that the former signification is implied by the South Americans. In fact, the Peruvian Indians sometimes call the bird *el gallinazo marino* (sea vulture), for it is a gluttonous devourer of carrion. The same trait is shared by the lesser fulmars; I found both the gray species and the Cape pigeon pecking at the floating carcasses of boobies and cormorants.

The albatrosses which I observed along the coast comprise three species, namely, the black-browed or spectacled albatross (*Thalassarche melanophris*), the yellow-nosed albatross (*Thalassarche*

culminatus), and the Galápagos albatross (*Diomedea irrorata*). The first two are regular visitors from the south, while the Galápagan species, known to the Indian fisherman as the *pájarote* (a name probably shared by other albatrosses), comes down seasonally from the tropical ocean and is common near the coast only when the warm current, El Niño, has checked upwelling from cooler depths.

Finally, I should note that far off shore, beyond the zone of low ocean temperatures, other Tubinares, such as a gadfly petrel (*Pterodroma cooki*) and a frigate petrel (*Fregetta tropica*), also occur; but these do not come within the ordinary field of coastwise commerce.

STEGANOPODES

This group, the "oar-footed" swimmers, includes the cormorants, pelicans, boobies, man-o'-war birds, and the long-tailed tropic birds. The last two are warm-water sea fowl which enter the northernmost seas of Peru only at certain favorable times of the year. Thus the *tijereta* (scissor-tail) or man-o'-war bird (*Fregata magnificens*) is not uncommon at Paita, but it pushes down the coast as far as Pascasmayo only during the manifestations of the warm countercurrent. The red-billed tropic bird (*Phaëthon æthereus*) is even more wary of the chilly Humboldt Current, but it is always likely to be seen north of Point Pariña, as well as anywhere far off shore.

To a lesser extent the camanay or blue-footed booby (*Sula nebouxi*) is also partial to more equatorial seas. It breeds regularly at no site south of the Lobos Islands, although its wanderings sometimes carry it southward to Ancon and Callao.

Of the five remaining birds of this order—one pelican, one booby, and three cormorants—three are endemic in the Humboldt Current. The fourth is the red-legged cormorant, found also in the Strait of Magellan. The fifth is the highly adaptable cormorant known as the *cuervo de mar* (sea crow), technically termed *Phalacrocorax vigua*. This bird is apparently superior to the climatic environment, for it ranges from Cape Horn to Canada, and is equally at home in the coastal ocean, the rivers of the forested interior, or the lofty mountain lakes such as Titicaca and Junin. The probable explanation is that the *cuervo* feeds upon almost any sort of bottom-living fish, of which there is no dearth in either salt or fresh water of various latitudes and temperatures. Blennies and eels are favorite morsels in the Peruvian ocean; a *cuervo* has been seen to bring twenty-two eels to the surface within the space of ten minutes. I often saw the birds emerge with a writhing fish held only by the tail, but they always juggled it without the least uncertainty as to the result, and then swallowed it head first.

The *cuervo* can be told from either of the other cormorants of the coast by its all dark coloration,

its habit of gliding for considerable distances on motionless wings, and especially from the half domesticated manner in which it haunts piers, water-pipes, anchored vessels, wrecks, buoys, and other man-made structures in the roadsteads. Its grunting voice sounds exactly like that of a pig, and is sure to deceive a newcomer until he has located the green-eyed birds—perhaps beneath the planks upon which he is walking, perhaps in rigging above his head. Quite the most surprising trait of the *cuervo* is the way in which it imitates a perching land bird. How its great webbed feet can hold its heavy body on the steep and slender headstays of a ship is beyond comprehension, but for hours at a time it rests and sleeps upon just such precipitous wires.

The guanay (*Phalacrocorax bougainvillei*) has had ample space devoted to it in Chapter IV. There is no mistaking it for anything else, because it is the only cormorant which travels in large flocks.

The last of the cormorants is the *chuita*, *chiquito*, *patillo*, or red-legged shag (*Phalacrocorax gaimardi*), peculiar to southern and western South America though related to a New Zealand species. It is recognizable from its bright red legs and face, its gray plumage, the elongate white markings on the sides of its neck, and its high-pitched, chirping voice, which seems very “unseabirdlike.”

While the guanayes nest in legions on the flat

tops of the islands, and the *cuervos* in haphazard clusters on outlying rocks, the *chuita* lives alone. It builds a bulky, ten-pound nest on some small shelf of a cliff, and rears its two black, downy young ones in seclusion. I found three nests only a few yards from one another inside a great sea cave on North Chincha Island, but, for the most part, each *chuita* homestead is a sort of hermitage.

In its feeding habits, also, this cormorant is inclined to be solitary. One rarely finds even a pair together, although once, off South Guañape Island which had the largest *chuita* population that I found on the coast, a compact flock of thirty flew past my boat.

From the rocks of Central Chincha, in October, I could watch individual chuitas diving for both food and nesting materials. When gathering the latter they would plunge repeatedly to the bottom in depths of four or five fathoms, emerging each time with a larger bunch of seaweed and tubes of marine worms in their bills. How they kept a grasp on the accumulating spoils is a mystery, but they would not fly to the chosen home-site until they had garnered a generous bill-full.

Unfortunately, the *chuita* is a preferred "game bird" of the maritime Indians, and, as the species is of no economic importance, neither law nor sentiment protects it. I was once served with boiled nestlings, but the dish left me with no taste for more. Two destructive pieces of apparatus seem

to be part of the habiliments of every island guardian. One is a pole of bamboo or sugar cane with a fishhook lashed to the end; the other is a long surcingle of webbing which supports his trousers. With the hook he yanks the poor young *chuitas* from their ledges, and with the strap he makes a a noose for hauling penguins out of their holes. Singly or in combination, indeed, the pole and strap are put to a variety of nefarious purposes.

The white piquero (*Sula variegata*), with its speckled back, will offer no difficulty of identification, for it is far and away the most abundant bird of the Humboldt Current, its population exceeding even that of the guanay. It is also the noisiest of the guano birds, a medley of whistles, gabblings, and trumpet-like calls ringing out from each community.

The life history of this species, and the astounding manner in which flocks of piqueros fall into the sea like hail-stones, are described elsewhere. It remains only to speak of an odd custom of single birds, namely that of associating themselves with groups of other species in flight. Wedges of guanayes or lines of pelicans are often accompanied by, or even led by, a lone piquero, as if the latter were a self-appointed sergeant major.

Finally, the pelican or alcatraz (*Pelecanus thagus*) reveals its identity as far as the eye can reach. This, like all the important guano birds, is found only in the Humboldt Current, for the peli-

can of Ecuador is the smaller West Indian species.

Formerly pelicans covered the plateaus of many Peruvian islands. This explains in part why the piqueros confine their nests mainly to the cliffs, for wherever I saw the two species breeding together, as at South Chincha Island, the eggs and nestlings of the boobies were quickly trampled out of existence by their huge, clumsy neighbors. But in competition with the mere presence of human beings, the timid pelican is invariably the loser, and thick beds of bones in hollows and gulches tell of hordes of young pelicans which have come to an untimely end. Thousands of these, it is said, were driven to slaughter by wanton guano contractors in the old time, purely for the sake of getting them out of the way of the diggers.

Although its day of glory has gone by, the pelican is still king at Lobos de Afuera. The sight of ten thousand incubating birds in one small valley, or of massed fledglings upon the hills beyond, or of the armies of adults that pour in from sea in stately and deliberate files, is never to be forgotten.

At the date of my visit, the pelicans were nesting in the hollows in large, irregular packs, which were usually considerably longer than wide. Other nests covered the old pier or stretched along the railways built for guano cars. Parts of the track were completely buried under new guano. In the depressions of the island most of the nests contained eggs or purple, naked young, but on the



Motion picture film.

A PORTION OF THE GREAT PELICAN COLONY AT LOBOS DE AFUERA.

embankments and hilltops stood droves of awkward, woolly, white youngsters, which looked like sheep rather than birds, and which made the vicinity sound like recess time in the playground of a school. Hundreds of adults alighted among these chicks while I was using the Akeley camera, and not a few of them revealed their strangely unintelligent temperaments by viciously biting half the young birds within reach.

The pelicans are the shyest as well as the stupidest of the guano birds. It is difficult to come anywhere near them without having them dash away, bumping into each other on the ground or in the air, and leaving their offspring to the voracious gulls. This is so likely to occur that they should never be approached without the utmost caution. Before taking flight, they usually open their great bills widely and empty themselves of a bellyful of fish. Sometimes even those soaring overhead express their excitement in the same way, sending down a fearful rain of well digested anchovies.

A pleasanter picture is offered when the pelicans, unaware of observation, bathe and splash to their hearts' content in the quiet coves, or when they sail in circles under the blue sky, now and then performing contortions in order to scratch their heads with their claws. The pelican in flight is indeed a creature of dignity and grace; ashore it is a nondescript, a distinction well grasped in the verses of John R. McCarthy:

Before the thundering wheels of the sea's white chariots
You glide unswerving
As a gray angel, fearless.

Out of the winds,
Down-streaking like a shaft,
You are the grim bird-lightning of the sea.

Upon the rock,
Ungainly, shapeless,
Your ogre's beak protrudes like a too-eager belly.

For God's sake, Pelican,
Spread your wings and glide!

SHOREBIRDS

The quiet shoreline of Peru is a favorite winter haven for migrant snipes, plovers, and curlews from North America. Space will not permit a description of these, but familiar species, with the Peruvian names of some, include the turnstone or *chorlito* (*Arenaria interpres morinella*), the surf-bird (*Aphriza virgata*), the first known nest of which has but recently been found in Alaska, the wandering tattler or *zarapito* (*Heteractitus incanus*), the Hudsonian curlew or *zarapito real* (*Numenius hudsonicus*), the *chigüitos* or semi-palmated and western sandpipers (*Ereunites pusillus* and *E. mauri*, respectively), the sanderling (*Calidris leucophæa*), the black-bellied plover (*Squatarola squatarola*), the ring-neck plover or

chinita (*Charadrius semipalmatus*), and the swimming *pollitos de mar* or phalaropes, of which flocks of two species (*Phalaropus fulicarius* and *Lobipes lobatus*) may often be seen a mile or more off shore. Nor should I forget the friendly little spotted sandpiper (*Actitis macularia*), which the Peruvians know as the *til-til* for the same reason that we call it "teeter" in its summer home.

The visiting turnstones behave rather strangely from our northern point of view, for in Peru they rest in flocks on lighters in the busy harbors and perch upon the supporting framework of the long piers.

The native, permanently resident shorebirds include the snowy plover or *cajero* (*Charadrius nivosus*), which is difficult to see as it scurries over the white sand, and two striking species of oystercatchers or *brujillos* (little wizards).

The black oystercatcher (*Hæmatopus townsendi*) is an inhabitant of rocky shores on both mainland and islands. It is of southern affinities, ranging up the west coast from Cape Horn and the Falkland Islands. The other species, the *brujillo de pecho blanco* (white-breasted wizard), also known as the *pitanay*, belongs to a more tropical species (*Hæmatopus palliatus*). It is a bird of broad sandy beaches, so that the habitats of the two oystercatchers alternate instead of coinciding. The white-breasted form is rare on most of the Peruvian islands but common in relatively shel-

tered bays. Both oystercatchers make loud and hysterical music, the most spirited bird calls of the whole coast.

FLAMINGOS

The Peruvian *flamenco* (*Phaenicopterus chilensis*) is typically a bird of the Andes, where it is reputed to breed in high mountain valleys. At certain seasons, however, flocks of adults in the pink and red plumage descend to sea level. Independencia Bay, the head of Paracas Bay, and the salt lagoons south of Huacho are favorite rendezvous on the coast.

GULLS AND TERNS

The littoral members of this group, in its broadest sense, include no less than six kinds of gulls, four of terns, two of skuas, and the skimmer. Most of them can be readily identified by the process of elimination.

Gaviota is the general native name for the gulls, although the word is chiefly confined to a single kind, the *simeón* (*Larus belcheri*).

The first species to be encountered on the southward voyage is the kelp gull, *cleo*, or *cau-cau* (*Larus dominicanus*), a big black-backed bird which makes its appearance in the latitude of Cape Blanco. This is the only gull that regularly follows steamers, often alighting on the superstruc-

ture and swooping into the wake for garbage. It confines its attentions entirely to coastwise vessels, however, quickly leaving one which heads out toward the warm high sea. The kelp gull is of extraordinary distribution, for it occurs on antarctic islands all around the pole and yet pushes northward through the tropics as far as the Humboldt Current bathes the South American shore. On the Atlantic side it nests only in Patagonia, but in the Pacific it reaches Lobos de Tierra.

The ordinary *gaviota*, or *simeón* (*Larus belcheri*), is a smaller gull of similar appearance, but it can be distinguished by its banded tail, the gray, instead of white, lining of its wings, and its bright yellow, instead of flesh-colored, legs and feet. It nests close to the breaking waves on the smaller rocky islets, and is unknown outside the Humboldt Current. Like the *cleo* it is a notorious egg-thief, and a veritable harpy in the colonies of guano birds.

On their hunting ground these two gulls share the habit of putting their bills between their legs when they begin to scream, afterwards raising them and holding the mouth wide open for the raucous finale. In this way they show another distinguishing character, for the tongue and lining of the mouth are pale yellow in the *cleo* and brilliant orange in the *simeón*.

The only other truly coastal species is a pretty, inoffensive, somewhat ploverlike small gray gull (*Larus modestus*), called the *mateo* ("worrier")

from its plaintive, mournful cries. It nests only on the mainland, but during the greater part of the year it frequents such islands as have sandy strands, where it feeds in droves upon crustaceans in the wave-wash.

The three remaining gulls are seasonal visitors from the north or from the high mountains. A black-hooded, rosy-breasted gull, about the size of the *mateo*, is the *serranita* or "mountaineer" (*Larus serranus*), which descends from the Andes to wet its wings in salt water during the southern winter (May or June to November). A much smaller black-headed species is the *pardelita*, or Franklin's gull (*Larus franklini*), an enormously abundant tourist from interior North America. The last is the silver-winged, fork-tailed Galápagan gull (*Creagrus furcatus*), usually seen in small bands well off shore. It is seldom to be observed at close range for it is mysteriously shy at sea although absolutely fearless when at home in the Galápagos Islands. It can be identified by the combination of smoky mantle, dark head, and a striking white patch on the inner wing.

Of the four common terns, one is a migrant from the north, the others native. The arctic tern (*Sterna paradisæa*) accomplishes one of the longest of known migrations and is a regular transient in Peru. It is a difficult bird to recognize with certainty, but it will not be seen often enough to confuse the average observer.

The most distinctive of the terns is the endemic *zarcillo*, *aromito*, or Inca tern (*Larosterna inca*), an exquisite, slaty-black, coral-billed creature with no near relatives. The most used Spanish name, *zarcillo*, means ear-ring, but the white, curved, feathered, ornaments on either side of the bill remind one more of moustaches. The *zarcillo* is a lover of rocks nesting in burrows and crevices, not infrequently laying its eggs in a niche in the wall of a penguin's dug-out.

Asia Island was the chief center of abundance of the *zarcillo* during the period of my field work, although it was common at all islands as far north as Macabí.

No birds could be more inquisitive than these. On the nesting ground they hover in front of your nose until you must step backward or look cross-eyed. They gather at once about any moving object in the ocean. In fact, they usually foretell the rising of a seal or whale by fluttering above the swimmer, which they can doubtless descry fathoms down in the blue water.

The two remaining terns are much alike except in size, both wearing the conventional pale gray, black-capped plumage. The larger is the *terrecla* (*Sterna hirundinacea*), a bird which, like the kelp gull, is equally at home in the antarctic and along this tropical coast. It often follows shoals of porpoises and of large predaceous fishes, such as the *corvinas*, for which reason the fishermen sometimes

call it *el corvinero* in the same sense that New England sailors know our terns as "mackerel gulls."

The tiny *churi-churi* (*Sternula lorata*), so called from its singing calls, is one of the smallest of terns, and is peculiar to this coast. Previous to my visit its breeding habits were unknown, but I learned that it nests not on the beetling cliffs, as had been suspected, but on the coastal plain or *tablazo*, well back from the sea.

South of Pisco and at Pacasmayo I saw the *churi-churis* flying inland over the stony desert, and heard them burst into cadences of mellow calls notwithstanding the fact that they were all carrying minnows crosswise in their bills. At Pacasmayo, in January, it was easy to discover their secrets, for, when I had followed the line of flight a mile back from the beach, small groups of the terns dashed significantly toward my head, chattering angrily. Ignoring these birds, I sat down and quietly scanned the more distant parts of the plain through glasses. Presently I saw a *churi-churi* alight about a thousand feet away. It stood still and seemed to look all around. Next it preened its feathers in an abstracted manner, and pirouetted several times. After that it trotted straight to a spot ten or twelve yards off and settled down. I glued my eyes upon the bird and started toward it. It soon flew, but, without changing my glance, I walked ahead and found its two eggs, which looked

like harmonious pebbles on the sun-burnt *tablazo*. By following the same tactics I soon discovered two more eggs, and an equally well camouflaged chick. In each instance the parent descended at some distance, and completed its cautious scouting before approaching the bare site which took the place of a nest.

The skuas, which bear the names of *halcón de mar* (sea hawk) and *pájaro ladrón* (thief-bird), include one migrant from the cold north and another from the cold south. The southern skua chances to have a scientific name which is really appropriate — *Megalestris chilensis*, the “big Chilean pirate-ship.” It is a tawny reddish or dusky bird (according to its individual color phase), recognizable from the large white spot in its wing and from the rakish manner in which it pursues and harries the piqueros and other defenceless fish-eaters, inevitably forcing them to disgorge their hard-earned meals.

The northern member of this group is the parasitic jaeger (*Stercorarius parasiticus*), of the same general aspect, but smaller and with long central tail feathers. It more or less avoids competition with its big antarctic cousin by tyrannizing over the terns instead of the larger birds.

Finally, the long-winged, black and white skimmer (*Rhynchops cinerascens*), well named *el arador* (plowman) from the way in which it cuts the water with its elongate lower mandible, confines

itself mostly to sheltered bays, such as that of Paracas, and is not likely to be seen on the high sea.

BIRDS OF PREY

A small number of hawks and vultures appear often enough over the coastal ocean and at the islands to require passing mention.

The great condor or *buitre* (*Vultur gryphus*), described elsewhere in my narrative, allows the toothsome eggs of the helpless guano birds to tempt it away from its ordinary life of scavenger. We usually think of the condor as a bird of ethereal mountain peaks, but bare, treeless country rather than altitude is what it requires. Near the southern tip of the continent it ranges to sea level on the Patagonian plains, avoiding the rain forest region of Chile. At the southern end of the Chilean desert, however, it crosses the mountains and occurs thence throughout the western slope of the Andes in Peru. But in the north, where the Humboldt Current departs from the coast, the range of the condor turns inland, and in Ecuador and Colombia the bird is not known at levels below the mountain grass lands, ten thousand feet or more above the sea.

The *gallinazo* or turkey vulture illustrates the same type of distribution in an enhanced degree, for the vulture of the west coast is the Falkland Island race (*Cathartes aura falklandica*), distinct from that of the territory east of the Peruvian



CONDOR IN FLIGHT ABOVE THE GUANAY COLONY OF ASIA ISLAND.



Motion picture film.

A SLOPE OF "CRATERS"; GUANAYES AT PESCADORES ISLAND.

Andes. The black vulture (*Coragyps urubu*) occurs widely on the mainland, and is abundant in Lima; but, curiously, it avoids the seashore. This is the reverse of conditions in the southern United States, where the black vulture is the coastal bird and the turkey vulture the inland bird.

The *gallinazo*, unlike the condor, breeds upon many of the Peruvian islands. At Vieja I collected eggs, as well as a newly hatched downy chick which the cabin boy of the 'Alcatraz' called a *gal-linazito chiquitito*—the very essence of something diminutive, expressed as only the Spanish tongue permits.

A peregrine falcon (*Falco peregrinus cassini*), the *gavilán* of the Peruvians, frequents the islands, taking toll of the diving petrels and other victims, besides which a native *cernícalo* or kestrel (*Falco sparverius cinnamominus*) often flies off from the mainland, perhaps in search of the more abundant insular lizards.

SONGBIRDS

Last of all, the only small land bird which has a place in my catalogue, is the *chirote de mar* (sea mockingbird) or *marisquero* (*Cinclodes taczanowskii*). A pair or two occupy the majority of the islands, an anomaly among the hordes of ocean fowl. From the balcony of my residence on Central Chincha Island I could see the *chirotes* at almost any hour as they fed upon the sandy beach.

Their clear, whistled trills were pleasant and home-like sounds at dawn of every day, the singing being usually accompanied by a rapid flashing of the wings as they sat on the highest peaks of the rocks.

The name *chirote* has reference to appearance rather than to powers of mimicry, the general resemblance to a mocking-bird being increased by the presence of a white patch in the wings. The bird is a member of an exclusively South American family, and it enjoys the distinction of being the only resident songbird at any of the Peruvian islands. Its feeding habits are more like those of sandpipers than of land birds, however, for I most often saw it standing on rocks assailed by heavy surf, or chasing retreating waves for the tiny crustaceans sucked out of the sand by the backwash. But at other times it did not disdain to be a fly-catcher, or to hunt in refuse for the egg cases of various insects.

The affinities of the *chirote* are with birds of Patagonia, Tierra del Fuego, and the high Andean stream courses, but on seacoasts bathed by the cool Humboldt Current it ranges northward at least to 10° south latitude.

At Pescadores Island, in December, I discovered the first and only known nest of this species, a substantial structure of fine seaweeds and feathers, containing two pure white eggs and situated in a dark cleft of the rock about fifty feet above the

surf of a gorge. In many other places I saw mated birds tumbling like cascades over the cliffs and darting into grottoes below, but I learned nothing further about their homes or offspring.

CHAPTER XIII

THE FISHERMEN'S ISLES AND THE GUAÑAPES

No more picturesque group of islands is to be found along the Peruvian coast than the Pescadores, off Ancon, the nearest to Callao of all important modern guano stations. The main island, which bears only a remote resemblance to its outline on the sailing charts, is rough and irregular, with steep and jagged hillocks, narrow coves, many caverns and sea arches, and precipitous walls round its whole shore-line. The dome-like extremities of the isle, which are commonly darkened by colonies of nesting guanayes, are connected by a razor-backed ridge, and under this is a tunnel through which the surf rolls. Such are the beginnings of the division of one island into two. There is no landing beach on Pescadores, the narrow, boulder-strewn stretches beneath some of the cliffs being inaccessible from the top of the island. The one way of getting ashore from a boat is to scramble up a twenty-foot ladder which dangles from a suspension dock over the swelling sea.

Once on *terra firma*, the visitor looks in vain for

a level spot of ground. The quarters of the resident bird guardians reflect the topography, for the queer little cluster of shacks seems to be clinging at random to the steep hillside. In one of these buildings, balanced on a truncated point of rock sixty or seventy feet above the water, I spent several days in the middle part of December, 1919, not without a feeling that I was in imminent peril of slipping, house and all, into the sea.

From the summit of Pescadores, where the aneroid registers an altitude of 206 feet, one looks down at the lesser members of the little archipelago, the chicks of the old hen. Each of these islets of euphonious names—Turbado, San Pedro, Pantacabra, La Guaca, Las Hermanas, and Hormigas de Tierra—tempts a visit. Most of the smaller rocks are inshore from the main island of Pescadores, but Hormigas de Tierra, or “Ants near the Land,” covered from one year’s end to another with roystering sea-lions, stand like sentinels far to westward.

Several of the outliers of Pescadores are granite monoliths which have split, and, in falling asunder, have left between the halves a crooked chasm where the sea goes mad. It would be hard to imagine a more savage and lonely retreat than the gorge which cleaves Guaca. From its edge at sea-level the view of the other islets and the Peruvian mainland is cut off, and out of each end one sees but a short section of watery horizon. The rugged cliff

can be descended only by a route fit for mountain goats and the waves surge through the narrow cleft, dashing spray high up on the rock walls, which are consequently green to the top with slimy algæ. To stand beside such a secluded whirlpool, out of sight of the familiar circle of ocean and continent, but with the din of wild waters in your ears, is to feel the spell of Uttermost Thule.

After a memorable visit at the Pescadores, I waited in Lima for the sailing of a Peruvian light-house tender, the auxiliary schooner 'Piquero,' which was delayed from day to day until the twenty-eighth of the month. On the morning of this date I overtook the schooner by launch after she had already started toward Palominos Rocks, on which a light marks the course around San Lorenzo Island and into the harbor of Callao.

The 'Piquero's' sails were furled, and she traveled under power of an extraordinarily noisy and fummy engine. Her sheathing was foul; the mussels, barnacles, and weed could be seen anywhere below water line by leaning over her rail. Under these circumstances her speed, even before the wind, was at most five knots. To make matters worse, she rolled heavily in the swells. I anticipated a trip of few comforts but, before the first sunset, the friendliness and overflowing hospitality of Captain Pera and of Commandant Fernandini, of the lighthouse service, had created a new outlook. A few days later I had come to believe that

no voyage was ever made in such sheer contentment as mine in the 'Piquero' to the northern Peruvian isles.

The water of Callao Bay was filled with stringy, mucilaginous fronds of some unknown form of life as we chugged around the Whaleback and through the Boqueron. Many fishermen were at anchor near the southern point of Fronton, to which we gave a wide berth, and others were dredging scallops in the channel, propelling their chalupas by oars and sails together. In this part of the bay, according to local tradition, the first site of Callao has lain, fathoms deep, since the overwhelming earthquake wave of 1746.

For the greater part of the day the 'Piquero' lay at anchor off the central rock of Palominos, while the boats transferred oil and other supplies to the lighthouse keepers. About the time the lamp in the tower began to throw forth its beams, we laid our course for Mazorca. I spread my camp bed on the roof of the 'Piquero's' cabin, and spent the first of many nights under the stars.

Mazorca, of the Huaura group, the island that I had seen at close range from the 'Mantaro' many weeks before, loomed ahead when I awoke. Before eight o'clock we had rounded the western end and had let go the anchor close to the hanging dock on the leeward shore. Although the morning was calm, the swell beneath the landing was characteristically high, and it took all the resources of

three men to handle the boat while the supplies and my cinematographic outfit were hoisted ashore.

Mazorca is much disintegrated by the sea. The central mass of the island still has long slopes on both the northern and southern sides, but at either end the southern or windward face has been entirely pounded away, leaving only undercut cliffs which rise to a sharp crest. From this an even hillside, speckled with unsightly piles of loose stone left by guano contractors of old, declines to low cliffs on the northern side. The highest point of the island, at the base of the lighthouse, has an altitude above the sea of 328 feet.

The light, like that at Palominos, is a kerosene lamp manufactured at the Chance works, Birmingham, England. Since the time of my visit, Peru, in common with Ecuador, has adopted the Swedish gas-accumulator system of unattended lights, and has installed flashing beacons, of six-month capacity and with ranges up to twenty-one miles, at Central Chincha Island, Supe, Huarmey, Punta Parada, Infiernillos, and elsewhere. These, like all the older lighthouses, are in charge of the guano administration.

A zigzag pathway led us from the dock to the summit of Mazorca. On the hilltop I saw a sparrow, hopping about near the lighthouse. Such birds have no place in the fauna of a plantless guano island, but the presence of dead doves and other species in the same locality confirmed what



MAZORCA.



Motion picture film.

LANDING EQUIPMENT AT THE SUSPENSION DOCK OF MAZORCA.

the keeper told me about the occasional attraction of both land and sea birds by the light. There is apparently no record, however, of phenomena resembling the vast flights of birds which sometimes break like storms upon lighthouses along migration routes of the northern hemisphere. In the whole experience of the keeper at Mazorca, he recalled but one instance of a bird—a cormorant—crashing through a window of his island home.

We lunched in the cool breeze, on the shaded porch of a house near the summit, looking southward across illimitable blue water. The principal dish consisted of *cabrillas*, small rock fishes whose transit from pool to pan had been extremely quick.

The light of Mazorca had begun to flash before we headed northward on our plodding way. A light breeze traveled faster than the 'Piquero,' blowing the petroleum fumes forward, away from the quarterdeck and our nostrils. Low clouds scudded across the stars and the half moon.

At midnight the sky was clear, and rich with the strange blue shade which is so different from the blue of day; but toward dawn a fog formed and hung over the Pacific until well after sunrise.

Not a bird was seen on the misty ocean during the morning, perhaps because our course lay nearly twelve miles from the coast. The weather made it so difficult to observe landmarks that we nearly sailed past Lagarto Head, which directed us to our next port of call, Huarmey.

A strong southerly wind was blowing as we entered the jade-green waters of Huarmey Bay and plowed through a school of anchovies, with the usual flocks of piqueros, Inca terns, gulls, pelicans, cormorants and lobos feeding upon them. A formidable surf was breaking on a long beach, northwest of the spot at which we dropped anchor. Beyond, on the delta plain of the river, were groves of trees and other vegetation sufficient to hide completely the town of Huarmey. The landing place, and the house of the captain of the port, lay in another direction, below some rocky bluffs at the head of the bay.

Upon going ashore, I took a three-hour tramp over the soft marsh land. The country was very attractive in its greenness, with innumerable brackish streams, teeming with fish, growths of rushes ten feet tall, and impenetrable copses of *algarrobo* and other spiny trees, which were veritably alive with chattering hummingbirds. Bare, weathered hills around the borders of the river plain were almost the only suggestions of the type of coastal desert with which I had grown familiar in Peru. These proved to be composed mostly of water-worn pebbles, and their upper layers were in places literally packed with ancient human bones.

Not far behind the broad beach, but separated from it by a lagoon, was a hill among sand dunes which was topped by an old fort or temple. Returning to the shore from the marshes I could see the

surf dancing high on either side of the ruin, with the masts of the 'Piquero' just showing above the ridge of the beach. In the long reaches of meadowland back of the strand, mares with young colts were wading in the sloughs, munching the succulent water plants; Indians, who seemed to be part of their saddleless horses, were hurrying along winding trails; now and then an ox-cart with huge wheels would appear round some turn, to go rumbling along over sand, mud, rock and through the shallow fords of the creeks, until it disappeared in a jungle of reeds or thorns.

Birds were plentiful everywhere in the Huarmey oasis. Spotted sandpipers, ringneck plovers, and other migrant shore-birds from North America were feeding on the marshes; and our own barn swallows, which may conceivably have been hatched in New York, were pursuing insects just as in the summer at home. The native Peruvian birds included hawks of two kinds, mockingbirds, cactus wrens, red-breasted meadowlarks, vermilion flycatchers, white egrets and three or more species of hummingbirds.

Before returning to the 'Piquero' we called on the captain of the port and opened several bottles of *chicha*, the aboriginal beverage of Peru. Formerly this liquor was prepared by mastication of the first grains of corn used in the brew, somewhat after the manner of Polynesian kava, but now, at least on the coast, fermentation is produced by

less direct methods. The chicha of Huarmey is said to be particularly well known for its excellence. To me it seemed a rather insipid, malty drink, which left a pleasant taste in the mouth. It would undoubtedly be a blessing to the Republic if the Indians could be persuaded or compelled to stick to chicha, and to forego the far more disastrous gratifications of the white man's *pisco*.

We set sail after dark, with the foresail spread to aid the motor. A thick, penetrating garua fell all night, and the schooner wallowed so heavily in the long, rounded waves that I was decidedly uncomfortable on top of the cabin. After the wettest hours that I had yet experienced in Peru, during which moisture penetrated even my "rain-proof" sleeping bag, a dense morning fog prevented us from seeing more than a ship's length about us. Through the gray veil we descried from time to time rafts of sooty shearwaters, which rose at the approach of the 'Piquero,' to disperse and vanish with a rustle of pattering feet and beating wings. At other times the stillness of hours would be broken only when porpoises came to the surface and puffed an answer to our rickety engine.

On the last day of the year we passed along a beautiful stretch of desert coast, between Samanco Bay and the River of Chao, and at sunset we anchored inshore from the south island of Guañape.

As "guanay" means guano bird, Guañape

perhaps signifies a place of guano deposits. At any rate, the islands of this name have from immemorial times been second in fame only to the Chinchas. Many relics of the ancient people, moreover, have been found deep in the Guañape beds.

At dawn of New Year's Day I was awakened by the crowing of a cock on South Guañape. Shortly afterwards the administrator of the work on North Island, from which the shipping of guano had just been completed, came over to us in the launch 'Mollendo,' which was placed at my disposal. We started at once for North Island. In the strait the piqueros were falling like hailstones from an overhanging cloud of birds, and I took advantage of a long wished-for opportunity: we drove the launch through the midst of the plunging flock while I ground out motion pictures from the bow.

The trawler 'Alcatraz' lay at anchor off the suspension dock of North Island, so I stopped before going ashore to exchange New Year greetings with my old friend, Captain Tassi.

The leeward slope of North Guañape, from which 7,640 tons of guano had just been taken, was bereft of birds. The entire windward side, however, with the exception of a few sandy banks, was packed with breeding piqueros and guanayes. The former covered not only the steepest hillsides, but nearly all of the peaks as well. From a distance, the territory of the guanayes looked black, that of the piqueros gray. These mutually ex-

clusive areas dovetailed with one another, so that the distribution of the two species was revealed clearly in a photograph which I took subsequently from the summit of South Island, several miles away.

On all the low points of the eastern shore of North Guañape, full-fledged young guanayes were standing by thousands, frequently entering the water for swimming and diving practice.

After a reconnaissance of North Island, we returned to the schooner and then landed on South Guañape. Piqueros were still dropping like plumets all over the strait, closing their wings the instant before striking the water. So rapidly did they descend that they were visible only as white streaks followed by splashes like miniature mine explosions. Guanayes, *chuitas* or red-footed cormorants, and penguins were fishing among them, and I marveled, as always, that some of the surface-feeding birds were not transfixed by the winged arrows which fell all about them.

The cook at South Island, evidently proud of his noble profession, insisted on preparing a snack before we went on with our work. He served a remarkable salad composed of lettuce, eggs, alligator pears, peppers, plums, fish (*robalo*), and several unidentified ingredients, together with an abundance of Salaverry *chicha*. Next he produced three tall bottles of wine, but I protested that I had had sufficient New Year cheer for the middle of

the morning, and began the long, winding ascent of the hill.

Not one guanay lived on the high island of South Guañape and, except for the narrow domain of Inca terns and chuitas around the shore line, it was occupied by but a single species, the piquero. The breeding grounds of this bird spread from the magnificent western precipice, more than four hundred feet high, over to the pampa of the eastern slope, where the nests filled extensive spaces and presented one of the most beautiful scenes that could be imagined. The loftiest sites had the most advanced young. On the lower parts of the hill, for example, there were many fresh eggs, while at the summit countless thousands of full-grown chicks stood flapping their wings in the breeze, getting the exercise which is a necessary preliminary to flight. Still older chicks, which had left the vicinity of their nests, were encountered all over the island, resting or sleeping, striving to scramble up hill, or launching out into the air. One could never tell when such a youngster would come hurtling down from the heights, to alight with a thud close by. These fledglings were all extraordinarily tame; almost any of them could be touched or picked up. During the greater part of the afternoon five of our men fished from a rock upon which two of the young piqueros were standing. The surface was not more than ten feet square and the fishermen, who were continually

moving about while cutting bait or landing their catches, would stoop now and then to give the entirely undisturbed *piqueritos* a pat on the head or a playful chuck under the chin.

I have seen the penguin regiments of the Far South, the courtship antics of the great albatross, and other marvelous sights in which birds held the center of the stage, but nothing more exquisite or wonderful than the pantomime of *piqueros* hanging on the wind above the cliff of Guañape. The innumerable white birds would come sailing up over the nests on the plateau and, when they reached the brink of the escarpment, the up-draught would lift them like kites. Then for seconds, it seemed for minutes, they would poise, hardly changing their positions, but twisting their necks to look toward me, or to glance at their hopeful chicks below. Some of the graceful, living sea-planes were within ten feet of me, scores within fifty feet, and beyond they stretched away for a quarter of a mile until they seemed like fixed white specks in the sky.

After the 'Piquero' had departed from Guañape, all signs continued to tell us that it was now high summer on the Humboldt Current. Each night the wind blew gently from the landward side of south until the calm of daybreak, after which soft fogs rested upon the unperturbed Pacific. Out of the haze came, from time to time, the bewildered calls of land birds which had inadvertently strayed



PIQUEROS NESTING ON SOUTH GUAÑAPE ISLAND, NEW YEAR'S DAY, 1920.



BROODING PIQUERO OF SOUTH CHINCHA ISLAND, WITH CHICKS WHICH HAVE JUST
BEGUN TO SPROUT DOWN.

off shore. Sometimes, for an hour or more during the forenoon, we had to stop our engine, and to drift lazily under a foresail until we could make out once again the mountains of the coast.

Early one morning we passed the historic guano isle of Macabí, and before noon turned our bow in toward Pacasmayo. Simultaneously a rising southerly breeze lashed up white-caps, cleared the smoky horizon, and uncurtained the yellow, shining desert of the mainland *tablazo*; when we anchored in the roadstead, the customary afternoon gale was blustering its hardest, and a great surf was piling over the bar off the southern point. Far from shore the deep blue ocean seemed quiet, but lively waters, of the pale gray-green color so often noted before, extended a mile or more out from the beaches.

Beneath the long iron pier of Pacasmayo, at which we landed from the 'Piquero's' tender, the waves rose dizzily, leaving the struts all quivering as they surged past. Perched on these metal braces were numbers of turnstones from North America, and long rows of the *cuervos*, or black cormorants, which grunt by day and by night like droves of contented pigs. Sitting along the lee side of the pier were men and boys of every age between babyhood and the apparent station of great grandfathers—ninety-four I counted—and *one* girl, all angling for the rather inferior little fishes known as *moquarillas*. Upon second look, I found that the girl was only baiting hooks for one of the boys, so

she was not necessarily possessed of dangerous feministic tendencies! The bait in use was the familiar hippa or *mui-mui*, a crustacean which is as thick in Peruvian beaches as fleas on a llama.

Next morning I walked northward from the town, along a broad strand backed by cliffs of crumbly conglomerate, driving before me countless groups of small sandpipers and plovers, of which most were winter visitors from my own country. In a lagoon off the streamless mouth of the River Jequetepeque (pronounced "Heckety-pecky"), on a barely submerged sandbar, more than a thousand dainty Franklin's gulls, which were likewise tourists from the northern hemisphere, were standing in an inch of still water, their immaculate pinkish breasts and dark hoods reflected perfectly below. The river and all its sandy valley were as dry as a bone, but thickets of vegetation grew on the dunes in its bed, and from inland came caravans of burros laden with fagots, which wound down the trail atop the cliffs toward Pacasmayo. The gulch of the Jequetepeque rang with rich, tropical bird songs, and the nearness of the equatorial savanna lands was further indicated by a much greater variety of lizards than I had seen in the almost unalleviated deserts of the central Peruvian coast. I collected not fewer than six kinds of these reptiles, of which the largest looked as though it had been steeped in a rainbow. It was about fifteen inches long, and had a blue head with

a black band across the throat, a green belly, tail, and hind legs, chestnut breast and forelegs, and a red back sprinkled with light dots.

My outstanding memory of the brief call at Pacasmayo is associated with the *caballito* riders, the brown Indians who, for my special edification and a reward of two *soles*, paddled their graceful reed boats out through the surf to the southward of the town. Standing straight up on these 'sea-horses,' they hurdled the breakers with a skill akin to that of circus equestrians, and when, once beyond the last line of white-lipped waves, they turned again toward shore, they so maneuvered their strange and buoyant craft as to be caught by an advancing crest and propelled thrillingly to the very water's edge, like surf-boards.

The art of fishing from the *caballitos*, and particularly of determining the character of the bottom in depths of many fathoms, has been well described by Alexander Mann in a little-known book entitled 'Yachting on the Pacific.' Mann was formerly a resident of Guayaquil, who mingled much with the Indians of northern Peru. After he had ingratiated himself with them, he writes,

they instructed me in the philosophy of deep-sea line-fishing—which is to find a rocky bottom with seaweed growing upon it, to cast a well-baited hook with heavy sinker attached to the line, with a certainty of getting fish, the acme of the proceeding being the novel manner of distinguishing rock at from ten to sixty

fathoms below the sea-level. The little steed is propelled to a spot supposed to be a likely one, the rider's bare legs in the water; it is stopped for observation, which is accomplished by placing the wooden paddle vertically in the water, its stock end up, to which is applied the ear; if very deep the teeth are placed in contact with the stock, a rippling sound being clearly noted over rock, whilst a sandy or muddy bottom emits no noise. When the noise is heard these simple people say *ya lloa la peña*, or "the rock begins to cry," cast their stone anchor, and soon get plenty of fish.

The rationale of this art must be that the motion of the current is stopped on meeting the rock, or that the tangles collide in the water. I have repeatedly corroborated the depth and bottom, and have found rock at from ten to forty fathoms when the rock cried, whilst some distance away on sand or mud no sound could be heard—the Indian paddle a rustic marine telephone, discovered by this unsophisticated race hundreds of years before the birth of Professor Graham Bell.

In all that he records, Mann shows a genuine admiration for the aboriginal Peruvians of both the seashore and the hills. His concluding apostrophe is likewise well worth quoting:

We as a people are very apt to forget, perhaps are ignorant, of the fact that, scientifically, the Indians of the Inca period were our superiors in several of the sciences which conduce to the amenity and happiness of mankind, for in the sixteenth century Europe was far behind Peru in many of the principles of engineering and

agriculture. I have stood by some of the greatest suspension bridges in the world, noted the genius of Telford and Roebling, and smiled as I thought how, hundreds of years before either was born, Peruvian peasants trod safely across the wide gulches of the Andean rivers by means of bridges composed of vegetable cordage, in material very different but in principle identical with those modern works of genius. I have gazed amazed at the tunnels cut through the rocky sides of the mountains, to supply water with which these industrious peoples transformed the sandy Peruvian desert into fertile homesteads; travelled on portions of the road they had built for a distance of fifteen hundred miles along the plateau of the Andes, with its places of refuge studded along the route; and I have tried to decipher the cause of the downfall of the beneficent government of the Incas by a nation inferior in many respects to the vanquished; a superstitious reverence of the supernatural, the appearance of bearded men, the sound of gunpowder, the rider on his strange and unknown steed, even the awe shown by the invaders to the forms of religion—these influenced the gentle Indians to accept what appeared inevitable, though the want of union hastened the catastrophe.

CHAPTER XIV

THE LOBOS ISLANDS

THE high afternoon wind had gone down and it was a bright and placid evening, with the nearly full moon alternately vanishing and reappearing through the even bars of billow clouds, when we purchased our anchor and headed for Lobos de Afuera. The course was west-northwest, seventy-four nautical miles, and all through the night the surface temperature of the sea rose characteristically as we increased our distance from the coast.

It was a beautiful morning on the ocean as we approached the island. There was just breeze enough to ripple the sea and to temper the heat of the sun. Humpback whales and surface-swimming hammerhead sharks frequently exposed their backs and fins very near the schooner. Phalaropes and other small sea birds in huge flocks were always within sight, and when we drew close to Lobos de Afuera, great numbers of pelicans, for which the island is famous, together with scattered bands of the camanayes, or blue-footed boobies, came out as if to meet us.

Lobos de Afuera (which, freely translated, means "Sea Lions off Shore") is the roughest, most eroded island, or rather cluster of islets, that I saw along the coast of Peru. From shipboard the rugged, many-pinnacled group looks charmingly picturesque, lying in the azure Pacific with a white fringe of foam all around the shores. When the observer has landed, however, he becomes aware that, although the island is not without a certain scenic attractiveness along its rocky points and quiet coves, man has combined with nature to make large areas look like a year-old battlefield. Between the innumerable hillocks and ridges are sandy wastes which have been dug into at intervals of a few yards, so that the prospect is one of utter chaos. Here is an artificial gap in a ridge, through which the roadbed of a corroded guano railway runs; there a deep crater from which a few hundred tons of "fossil" guano have been mined; yonder are some well-like holes cut through the soil and rock by Chilean engineers, for nobody knows what purpose, during the time in which the triumphant enemies of Peru were taking a portion of their indemnity in guano. In still other places are tall steel piers or dumping-structures, from which the guano of the hilltops was poured into chutes and passed through wire screens in order to sift out the stones and gravel which now lie in enormous piles. These piles have been completely covered over again by the nests of boobies and pelicans, so that their

surface layers will eventually have to be sifted once more. Rusty tracks, half buried in new guano, wind about the central and northern parts of the main island; broken cars, twisted scrap-iron, cables, wheels, bricks, and all sorts of other long-enduring rubbish, protrude from the ground in many places. While in no wise interfering with the nesting of the birds, these unsightly objects rob this island of the clean, isolated, unvisited appearance which constitutes so great a part of the fascination of the others.

Much of the lower land of Lobos de Afuera is covered with a dense, finely pulverized, mineral dust, resembling dry cement, and due apparently to thorough disintegration of the rock. In the narrow valleys are deposits of ancient guano, likewise in the form of soft, heavy powder; into them one may sink to his knees if he mistakes the substance for hard soil. Pits have been dug into this pure guano for the purpose of obtaining deeply buried samples, but all of them, it is said, have proved relatively poor in nitrogen content. While filling one of my own tins with a supply from about six feet below the surface, I could not help but be impressed by the thought of what long periods of time, what legions of birds, and what unimaginable quantities of fish, have all contributed to the formation of the thick, homogeneous, brownish-gray mass which man has not yet disturbed.

The structure of Lobos de Afuera is not of the

clear granite of the more southerly Peruvian islands, but of metamorphic rock such as clay-slate, the layers of which have been tipped on edge through crustal folding. The softer stone is everywhere shattered, crumpled, or reduced to powder. On all the summits are exposures of hard schist which is covered with a curious glazing, so that the rock glistens in the sun. This glasslike coating, which is so thick as to round off the points and edges of good-sized outcrops and loose stones, is composed of a whitish deposit of some exceedingly hard substance. Similar glazing is familiar in many continental deserts and upon certain islands such as St. Paul's Rocks in the tropical Atlantic, and Barrington Island of the Galápagos. It seems to be due in part to the action of moisture upon guano, and for this reason it is lacking at the Peruvian islands south of Lobos de Afuera. Aridity is the foremost climatic characteristic of islands in the Humboldt Current, and most of them are absolutely rainless; but the two Lobos Islands, which are not far from the belt of humid tropics, are at rare intervals subject to precipitation. On March 7, 1913, a heavy downpour of tropical rain fell for more than an hour and a half at Lobos de Tierra.

On the highest hill of Lobos de Afuera, near the southern end of the main island, the lighthouse stands. On a beach below, beside an ancient deposit of guano which has been rendered nearly worthless by wind-flung spray, is the dismal spot

which I had learned to expect at every island—the Chinese graveyard—where garments, detached bones, and twisted corpses of the poor coolies have for many a long year been exposed to the merciless sun. No man now living knows fully the sordid history of guano exploitation during decades before the *Compañia Administradora del Guano* was dreamed of; but all of the suggestive reminders have not yet been swept away. One day, after contemplating the burial ground of the guano serfs, I turned toward the center of the island where, following Spanish tradition, a tall old cross tops one of the higher hills. Three vultures were dozing, side by side, on its bar. In some vague way the circumstance—vultures on the cross—seemed a fitting symbol for this desolate guano heap in the Pacific.

The bird population of Lobos de Afuera is nothing like what it was at the time of Coker's visit, twenty years ago, but the breeding pelicans, represented by perhaps two hundred thousand birds, are still an impressive sight. There are also goodly numbers of both kinds of boobies, the piquero and the camanay, the ranges of these species overlapping in this part of the Peruvian coast. A hundred miles farther south there are few if any camanayes; a hundred miles to the northward one would find no piqueros.

I hesitate to attribute the abrupt southern boundary of the range of the camanay wholly to

oceanographic conditions, because the food supply of this bird in the waters about the Lobos islands seems to be substantially the same as that of the other species. Nevertheless, as soon as a southward bound ship leaves Lobos de Afuera astern, even a casual observer may note that one gannet is rapidly replaced by the other—the realm of the camanay is succeeded by that of the snowy piquero. The latter is a swifter, more active flyer, and a far more powerful and spectacular diver than its northern relative. In this fact, perhaps, lies at least a partial explanation of the distributional limits, for it may well be that the camanayes cannot successfully compete as fishermen with the wonderfully specialized and multitudinous piqueros, which form an inseparable element of bird life in the Humboldt Current.

Lobos de Afuera and Lobos de Tierra are the only Peruvian islands which are not yet included in the control of the guano administration. The fertilizer of these islands, to the extent of more than seven hundred thousand tons, is still under general lien to the Peruvian Corporation, a British organization which at various times has become creditor to the Government. The American firm of W. R. Grace and Company acts, in turn, as agent for the Peruvian Corporation in the extraction of guano, and also assumes the obligation of protecting the resident birds. Through the courtesy of officers and representatives of Grace and Company, in

New York and Peru, I was afforded every facility for work during my visits to the Lobos Islands.

Señor José A. Stein, who is in charge of Lobos de Afuera, differs from Robinson Crusoe, and from the guardians of the southerly islands, in that his exile is shared by a wife and six children. A sister of Señora Stein is the wife of the lighthouse keeper on the island, and this couple have a daughter who bears the cheerful name of Luz-Angelica (Angelic Light). A third sister makes her home with the Stein family. So what with women and children, dogs, cats, a plentiful number of chickens, and goats to give milk for the babies, one corner of Lobos de Afuera has an almost rural aspect. It did not occur to me to ask what the goats ate; all vegetable products, however, as well as fresh water, must be transported from the mainland. Perhaps the hardy and adaptable ungulates, like the cattle of Iceland, subsist in part upon dried fish and seaweed.

There are also at Lobos de Afuera numerous Indians who have erected sheds in sheltered coves, and who carry on a considerable industry in salting and drying fish. The patriarch among them, an exceedingly dignified and well-spoken old man, had spent a large proportion of his time on this desert island for nearly fifty years. I am no judge of how correctly this white-haired fisherman spoke Spanish, but certainly his voice, his inflection, and his manner were extraordinarily pleasing. He told

us various tales of the old time, including memories of the Guano War of 1853-1854, in which his brother had been killed. The dignity and courteous bearing of this aged Indian made him a man to remember. His good qualities seem, however, to be shared in some degree by his fellows, for during subsequent association with the native fishing population of northern Peru, particularly with Indians from settlements between San José and Sechura Bay, I found every man kindly, hospitable, and trustworthy.

At seven o'clock of January 6, a calm, gray morning, we sailed away from Lobos de Afuera. Pelicans were coming and going in files of from six to three hundred birds as we passed out through the strait between the main islet and Cachimbo. Above the line of clouds in the east the high sierra of the continent was visible, but Lobos de Tierra, or the "Isla Baja" (Low Island, *i. e.* down wind and down current), lay out of sight below the northern horizon. Throughout the journey, bonitos, albacores, and anchovies, birds of many kinds, sharks, lobos, and porpoises, were about the schooner in the abundance which never ceases to amaze a beholder. Before noon we sighted Lobos de Tierra, dead ahead, and shortly afterwards we anchored in the transparent waters of the Caleta de Cherra, on the western side of the island.

Lobos de Tierra bears much resemblance to the face of the moon. Lying little more than six

degrees south of the equator, unshaded by frond or bough, its scarred surface is a chiaroscuro of white convexities and purple shadows. Throughout its five sea miles of length it is covered with crooked ridges, few of which rise more than two hundred feet above the ocean. Most of the higher peaks reflect a dazzling light, owing to the coating of "guano glass" on the rocks. The glare from the guano itself is almost equally brilliant, and the mid-day heat of the sun-baked surface would be hard to endure were it not for the dependable southerly breeze. The whole island is, of course, waterless, but veritable brook beds, which have been gouged through some of the gravelly stretches near the shore, tell of torrential rains that fall perhaps once or twice in a generation. Between the low ranges are irregular valleys, which are either narrow and stony and hence unsuited for nesting birds, or broad and deeply filled with guano. Tens of thousands of tons of the fertilizer are doubtless now available in the interior of Lobos de Tierra, for the ancient deposits have never been wholly depleted, and the birds have had an undisturbed opportunity to increase the supply since the departure of the last guano diggers, late in 1914, when the European War had begun to affect shipping.

Geologically Lobos de Tierra is doubtless closely related to Lobos de Afuera. It is made up of crystalline, metamorphosed rock, which has been puckered and kneaded by pressure like so much

dough. Milky quartz occurs in the form of veins and nodules.

The western side of the island is steep and irregular—a succession of exquisite, rockbound coves of clear, weedless water. The eastern coast, which slopes more gently, has a series of six smooth, sandy beaches, some of which are a mile in length. These are covered with seaweeds within the tidal range, and a profusion of the same plant growth usually reddens the water for a few yards from shore.

Lobos de Tierra is unique among all the low islands of the Peruvian coast in that it has what may by courtesy be termed a terrestrial flora. Minute green algæ color a few of the higher rocks along the western border; and a small, fleshy-leaved flowering plant, which the fishermen call *lejuia*, grows sparingly on the beaches of the east coast. But the outstanding, almost startling, botanical feature of the island is a thorny, acacia-like tree, which stands in a sandy sink not far from the Caleta de Cherra and within sight of the light-house. Deriving its water presumably from ocean seepage, this anomalous plant—a single representative of a single species—has contrived to eke out a lengthy existence. According to the most venerable of the Indians, its twisted trunk and bent branches, which reach barely three feet above the ground, have had their present appearance as far back as memory and tradition go.

The animal life of Lobos de Tierra presents certain striking differences, due partly to climatic and partly to physiographic conditions, from that of the southerly islands. Lizards of the familiar sort, practically indistinguishable from those of the Chinchas, are extremely abundant, besides which I found small, nocturnal geckos, similar to the one taken at Paracas Bay. Two species of birds predominate over all others on the island, these being the camanay and its enemy the *cleo* or kelp gull. The camanay, as has been noted before, extends its range southward to this region from the tropical waters of the Gulf of California; the *cleo*, on the other hand, is an essentially antarctic bird, which finds at Lobos de Tierra its northernmost breeding ground. It is extraordinarily interesting that two species of such diverse origins should make this island their common center of greatest abundance. Neither the camanay nor the *cleo* has a selected breeding area on Lobos de Tierra; both nest in great numbers everywhere—high and low, on sand, guano, or rock, on the shores as well as among the hills.

The piquero, the guanay, and the pelican likewise reach the northern boundary of their range at Lobos de Tierra. Of the three birds, the pelican is as yet most fully established at the Lobos Islands, obviously outnumbering the other important guano-producing species. The guanayes have at present only one colony on Lobos de Tierra, and



THE SINGULAR TREE OF LOBOS DE TIERRA.



FAMILY OF CAMANAYES OR BLUE-FOOTED BOOBIES, LOBOS DE TIERRA.
Lying in front of the adult birds is the body of a young kelp gull which they
have just killed.

none on Lobos de Afuera. Piqueros are common on both islands; at Lobos de Tierra, which is devoid of cliffs worth the name, they have adapted themselves curiously to the topography by being content to nest on flat ground, not only near the water but even in the heart of the island. There were seven such piquero colonies at the date of my visit. Their appearance, as they were viewed from adjacent hilltops, was strangely unlike the precipitous eyries in which I had usually found the piqueros at many islands between the Ballestas and Lobos de Afuera. The adaptability of this progressive species leads one to speculate as to whether it is not steadily winning out over the timid pelican, and whether the latter bird may not ultimately be eliminated as a significant producer of guano even in its last stronghold near the northern end of the Humboldt Current.

During my nine days' stay at Lobos de Tierra, I made headquarters in a commodious empty dwelling belonging to W. R. Grace & Company, and enjoyed the hospitality of Señor Otto Nicholas, resident guardian of the birds, Señora Nicholas, the family at the lighthouse, and the communities of fishing Indians from San José. The latter had established stations in three parts of the island, and were busily engaged in salting or drying many kinds of fish, of which sharks made up the bulk in quantity if not in numbers.

Soon after landing I commenced to select ex-

amples of all the fishes then being captured by the Indians, and thereafter found that the kindly fishermen vied with each other in sending the small boys with specimens for my cans. On the very first day, at Caleta de Cherra, I obtained a kind of snapper of a bright red color, bearing a superficial resemblance to the tropical squirrel-fish. It was known by the vernacular name of *estrella* (star), and was said to be a choice food fish. It has proved to be a new species, and has recently been described technically as *Neomænis peru*. The fact that a staple fish, salted in large quantities at the Lobos Islands, should be unknown to science is, perhaps, a sufficient comment on the field for zoological work which still exists in the Humboldt Current.

At Lobos de Tierra I saw no evidence that the fishermen ever resort to the nefarious practice of dynamiting. Their equipment, including boats, nets, and lines, was effective and well cared for, and their hauls were usually successful. Mackerel were running well, the average catch for each man on good days being about four hundred fish, all taken on hand lines. The treatment of mackerel was very similar to that followed in the United States, and the men were, naturally, highly skilled in the cleaning process, which required not more than six movements for each fish. One cut and a pull removed the gills; another cut laid the fish open from the back; two cleared out the entrails; and the last made a slash in the thicker half of

the body containing the spine. It was done within less time than is required for reading this description, after which the mackerel were washed and salted down.

The principal fishing station, in a broad, sandy cove near the lighthouse, was a quaint spot, with its line of driftwood shelters surrounded by stone bins for mackerel and row upon row of bamboo racks from which split sharks and rays were suspended in the sunshine. Three or four flags of the Republic always fluttered in the breeze above the huts, and the interiors were gay with homespun blankets, painted calabashes, great earthen jars, and gilded shrines, while nets and other tackle hung in pleasing confusion from the walls. The Indians who had not gone fishing were active from morning till night among their boats and gear. Along the waterfront a flock of kelp gulls never ceased to quarrel noisily for the offal, which was, from time to time, tossed out for them to dispose of. Some distance behind the row of living quarters, stood a wooden chapel just large enough to contain a cross and its trappings, the latter comprising all the implements associated with the crucifixion, such as a hammer, a linen garment, dice, a spear, a crown of thorns, a goblet, etc.

On one of my visits to this settlement (if it may be so called, for the women and infants had all been left on the mainland), I took a roll or two of motion pictures, whereupon the fishermen shook their nets

and twisted their twine with redoubled vigor, amid many expressions of general good humor. Everyone was so clamorous to be included in the show that I had to adopt the subterfuge of grinding the Akeley camera long after all the film had been exposed. Subsequently a keg of chicha was tapped in honor of the occasion, and the gourd cup, filled by a wrinkled, white-haired Indian, was ceremoniously passed from hand to hand until I, the last man in the ring, had taken the first drink.

Otto Nicholas and an elderly Indian named Loro, who was also in the employ of Grace & Company, proved very obliging in carrying my cameras and naturalist's paraphernalia to all parts of Lobos de Tierra. We had many pleasant tramps over the crusty ridges; or along weed-strewn beaches off which green turtles stuck their heads above the swells; or across the inland guano fields where the dust would be sucked up by little whirlwinds and carried along in the form of immensely tall, slender columns which moved slowly past us, like walking towers, toward the northerly end of the island. Even at a distance of but a few feet from these "guano-spouts" no atmospheric disturbance could be felt, and they often sprang up from the earth when no wind was otherwise perceptible. We visited the notable "tree," the burial places, the various pelican colonies, and the evil-smelling seal rookeries, where the jolly lobos would tumble off the rocks at our approach and play in the waves—

rubbing, caressing, and kissing each other, and sometimes concertedly whipping the water into froth with their flippers like so many boys in "the old swimmin' hole."

Lobos de Tierra supports a varied feathered population, but far and away the dominant guano bird, and one of the two most abundant birds of any kind, is the camanay. Its only rival in numbers is, as has been previously stated, the kelp gull. The camanayes, unlike the other guano birds, are not truly colonial, and yet their nests are often very close together. Sometimes, too, they are situated within a few feet, or even inches, of those of piqueros or of gulls. Looking in any direction over Lobos de Tierra, from practically any spot on the island, one can hardly fail to see thousands of irregularly distributed camanayes, here in rather dense aggregations, there scattered thinly.

During my stay the breeding of the species was in all stages. Fully grown, dark-breasted, brown-eyed fledglings, which had left their nests and parents, were common everywhere, especially near the water's edge where they stood in flocks and exercised their wings by violent flapping. Otto Nicholas called these *primeros*, or first-brood young, and stated that the eggs from which they had hatched had been laid during October. Then there were sedentary downy chicks of various ages, of which the younger examples were scarcely distinguishable from the nestling piqueros. Sets of

three eggs, more or less incubated, were in many of the camanay nests, and sets of two or only one egg were no less numerous. Finally, a large proportion of adult camanayes were love-making on their proposed nesting sites, so that a great many eggs were apparently still to be laid.

Because of the character of its nesting, because it is the least susceptible to disturbance of any of the birds, and because it goes right ahead with all the actions of its normal life in the presence of a human observer, the camanay is by far the most entertaining of the guano birds. It is curiously stupid in some ways, for, while it insists on laying its eggs beside your doorstep or in the middle of a frequented path, it never ceases to resent the passage of men or dogs, and will scold just as angrily the twentieth time in a single day as the first. The trail leading from Caleta de Cherra to the lighthouse of Lobos de Tierra, for instance, was traversed many times daily by a considerable number of persons, and yet the camanayes, which had planted their families from one end to the other of the well trampled ground, threatened with unabated ardor whenever the path was used.

As pointed out previously, the adult males and females of the camanay have clearly marked differences. The female, which is a heavier bird than her mate, has a strident, trumpeting voice, and an exceptionally large pupil; the iris, in fact, has the appearance of blending in a peculiar way with the

pupil, the latter being surrounded by a ring of circular, pigmented spots. The male is endowed with a soft, plaintive, whistling voice, while its pupil is of the small or "normal" type which permits much more of the yellow iris to show.

As regards the voice, I found that the male camanay is equipped with a double sounding-box at the junction of his windpipe and bronchial tubes. The throats of the females, and of the young of both sexes, show no such structure, and this observation led to the interesting discovery that the young males, as well as their sisters, have the same resonant, ear-splitting call as the *adult females*. The change in the voice of the males comes with maturity, when the delicate vibrating membrane of the vocal organ grows out to form a hard, egg-shaped chamber, thus converting a trumpet into a whistle!

The courting of the camanayes is extremely amusing, and, so long as an observer does not come unreasonably near them, the birds have no objection to being watched. I have frequently witnessed the performance from a distance of ten feet. They begin their advances very early in the morning and continue, judging from vocal indications, well into the darkness of night. Nothing could be more comical than the manner in which the male, with his tail cocked up like a wren's, goose-steps and waddles about, raising his bright blue feet as high as possible and thrusting forth his chest. After

strutting round and round in this way for a few moments, he will turn toward the female, who may be several yards away, and, bending forward and raising his wings, he will utter a most beseeching little whistle. This may be repeated several times before he begins to strut again. Then he may pick up a feather, shake it so rapidly that his whole head appears as a blur, and finally lay it gingerly on the ground, which is perhaps his method of suggesting a location for the nest. I often saw several males behaving in this way before one female, especially in early morning, the lady usually assuming an air of utter indifference.

During the later stages of courtship, doubtless after actual mating, the female becomes more demonstrative, frequently touching the bill or the neck of her mate, and sometimes even raising her wings in response to his salutation. At all times, however, the males perform much more often than the females. Some time before the first egg is laid, the nest becomes visible as a slightly rubbed spot on the soil, and after this both birds stand close by the site until incubation begins.

I did not learn the length of time that elapses between deposition of the several eggs, but I noted that the chicks as a rule showed considerable discrepancy in size and development. Three eggs constitute the maximum set, although many nests never contain more than one or two. Indeed, among the families of well-grown chicks, two is a



Motion picture film.

THE COURTSHIP OF THE CAMANAY.

Male performing before the female, at Lobos de Tierra.



PIQUERO FAMILIES ON THE CLIFFS OF SOUTH GUAÑAPE ISLAND.

commoner number than three, but this may be due to the loss or sterility of one egg. Both sexes incubate and brood the young, and when one of a pair returns from sea to relieve its mate, the birds usually spend a long period in demonstrations of affection before one steps off the nest and the other promptly covers it. I most frequently saw this change taking place during the middle of the day, and I observed birds of both sexes incubating at all hours.

The arch enemy of the camanay is the equally abundant cleo, which is quick to swoop down upon exposed eggs or featherless chicks. Within six feet of me I have seen the gulls pick up camanay eggs and fly off with them. It should be noted here that the sitting camanayes abandon one egg much more readily than they do three, while they can scarcely be driven from the nests after their chicks have hatched. At least one parent is constantly with the youngsters until the latter have practically passed out of the downy stage. Rarely the adults will attack the cleos on the ground and boldly defend their offspring, but, while they are individually more than a match for the enemy, they are almost always losers, for cleos in the rear will steal their nestlings while they are defending them in front. The obvious bewilderment of a pair of camanayes which stand gazing into a robbed and empty nest is altogether pathetic. On the western shore of Lobos de Tierra I once flushed a bird

which had been sitting not upon eggs but upon two beach-worn snail shells, and I wondered whether the parents had pushed such hopeless nest-eggs into their hollow after the breaking up of their home by the gulls.

It is chiefly upon the pretty, innocent-looking, downy chicks of the cleos that the camanayes wreak revenge for all their wrongs. From the day they hatch, the young gulls are accustomed to leave their sea-weed nests at the fancied approach of danger, when, with complete ingenuousness, they will walk directly among the brooding camanayes, and even try to snuggle beneath them. Alas! The camanayes know the foe even in the mottled down of babyhood, and the young cleos are stabbed through the head or body by rapier bills. While the poor victim cries out in terror, the furious camanay may thrust a saw-edged beak into its open mouth and out through the back of its skull. More than once I have seen young gulls so impaled by the lower mandible of a camanay that the latter had to shake its bill violently in order to get rid of the burden. At such tragic times the screaming adult cleos descend from the swarm above to defend their helpless chicks. On at least two occasions I saw camanayes which were not occupying nests go out of their way to attack young gulls which were running over the rocks. The results were lively but very unintelligent fights in which many birds of both species took part, and in which only the un-

fortunate eggs and chicks of either suffered serious damage.

The turkey vulture is also an enemy of the camanay, though far less to be feared than the cleo. That the camanayes recognize it as a foe is clear, however. One day I flushed a fledgling vulture so that it launched off from a high ledge upon what may have been its first flight. To my surprise it was at once attacked in the air by camanayes, and knocked down to earth. I never saw them molest an adult vulture.

When a camanay sitting upon eggs is approached, its "hair stands on end" all over, particularly on the lower part of the back where the feathers turn forward into a reversed position. At the same time the plumage of the head and neck bristles like porcupine quills. Next, the bird begins to protest by whistles or trumpetings, according to its sex, and by striking out with its formidable bill. If it be a bird with well grown young it will come between them and the intruder and express intense rage, spreading its wings like a bittern and threatening with its wild eye and darting weapon. When both birds of a pair assume this position the scene is most striking. The youngsters, likewise wielding ready and effective beaks, stand as a rear guard, all the while swearing in a raucous voice inherited from their savage mother.

Young camanayes, like the chicks of the other guano birds, are persistent in begging to be fed, and

the heads of a whole nestful sometimes disappear down the parent's gullet as they seek their half digested luncheon. The adults disgorge, when excited, much less freely than their relatives, the piqueros. One incubating bird, however, was observed to eject from its crop and throat a herring ten inches in length.

In its feeding habits the camanay frequents shallow coves much more than the other species of booby, making cautious, slanting dives into the water, and swimming more or less upon the surface. Farther out at sea, however, I have seen it making long straight plunges with very nearly as much verve as the piquero.

The camanayes form no high ring of guano around their nests, as the piqueros do. The accumulation seems to be relatively slow, old nests being encircled only by a broad, flat, whitish frosting. Although the guano contribution of the species is, therefore, not spectacular, it assumes considerable importance when the birds are left undisturbed for long periods of years, as they have been recently. Their mortality appears to be light, certainly less in proportion to numbers than that of the other species. The dried carcasses of young camanayes were nowhere numerous at the date of my visit, whereas the Lobos pelican colonies of former seasons were strewn with chicks which had failed to survive in the merciless struggle for existence.

On the morning of January 15, I left Lobos

de Tierra in an open boat rigged with a lateen sail. Old Loro, to whom I had given a pound on the previous evening, came down to the wharf with his two boys to express a demonstrative farewell. Otto Nicholas and three Indians manned our little craft, with Otto's wife and a dog as supercargos. The highly unnautical lady became seasick almost before we had cast off our warp, whereupon she crawled under the small deck in the extreme bow, and we neither saw nor heard any more of her during the thirty hours of the voyage. The dog stayed with her, but everybody else, including Otto, forgot her completely.

Our course lay well to southward, but the wind was such that we could only stand directly offshore from the eastern coast of Lobos de Tierra. The boat was none too comfortable, being piled high with all my luggage besides many bags of sand ballast, bundles of fire-wood, water-kegs, heaps of dried sharks and other fish, large gourds, sacks containing the belongings of the crew, rugs, and a spare sail smaller than the one in use. Reef points seem to be lacking on the canvas of all Peruvian fishing boats; the way to shorten sail is to bend on another of lesser size. Along each gunwale of our craft a balsa log was lashed, the function of these being to prevent us from lying over far enough to ship water, regardless of the force of the wind.

Within an hour we went on the port tack, and I noted for the first time the energy expended by

four strong men in bringing about a boat under the Peruvian lateen rig. In the first place, the single shroud or brace of the mast was shifted over to the side which was about to become windward, where it was drawn taut with a tackle. The boat was next worn around, instead of being luffed across the wind; the main sheet was loosed and passed forward, the clew of the sail being pulled by hand around the forward edge and carried to the rear along the opposite beam, outside all stays. The single spar of the sail was then tipped until it could be swung on its cordage pivot around to the opposite side of the mast. By this time the boat had been brought about, or rather jibed and, finally, after the sprit had once more been pushed tightly into its eye on the forward clew of the sail, and lashed to the mast, and after the main sheet had been poked through a hole in the stern-board, we headed on our new tack with a prospect of gradually regaining the lost leeway.

We passed within hail of the fleet of island mackerel fishermen, who were working not only from boats but also from long dugout canoes and from log balsas. Two tacks brought us abreast of the southern point of Lobos de Tierra, whence we laid our course, by the wind, for the mainland of Peru.

Although the morning was cheerful, with a bright sky and sea, the wind was too light for good sailing. Fish were jumping plentifully, and we

amused ourselves by catching large bonitos on a trolled hook. Birds were likewise abundant, but I was prevented from collecting any of the latter by the obviously colossal task of bringing about the boat. When breakfast time arrived, our resourceful Indian skipper made a stove from a gasoline tin, the bottom of which he filled with sand, and cooked an excellent mess of rice over a wood fire.

Two miles from the island we saw the first sooty shearwaters, called by our boatmen *doñanas*. Boobies of both kinds were also about, groups of fledgling camanayes resting on the water and often rolling on their sides after the manner of penguins. Great flocks of the little terns called, from their notes, *churi-churis*, were fishing, together with small petrels or *felices* ("happy ones") of two species. When we had left the island five or more miles astern we encountered numbers of Galápagos albatrosses, which generally took the air before we drew very near them. They seemed to fly in a labored way and to beat their wings more rapidly than the albatrosses of high southern latitudes. Still later in the day we saw several guanayes, which must have been more than twenty miles from their nightly roosting place.

In mid-afternoon we cut through one of the great "red seas" which are so familiar in the Humboldt Current. The water varied in hue from that of weak coffee to an almost bloody tone. Whatever the organisms which muddled the ocean may

have been, they were evidently of microscopic size, for no swimming crustaceans or other visible creatures could be detected. Shortly after this the bumpy sky-line of Lobos de Tierra faded from sight, and our clumsy boat became the center of a world without land-marks.

During the whole day the wind gradually increased, and also swung off so that we were able to bear more and more to southward. At evening it was fortunately still holding. The early part of the night was clear, after a glorious sunset, but later a heavy mist fell. I slept a little on planks stretched from gunwale to gunwale, with Otto and the Indians crowding me to a state of discomfort which was no doubt strictly mutual. Toward morning the mist dried up and the last vestige of wind died away.

When I awoke from a final doze, we were rolling gently somewhere off shore from San José. A dense fog obscured the land, and, even when the morning calm was succeeded by a good breeze, we were unable to determine our whereabouts until we sailed close by the end of the long pier at Pimentel. Here birds of many sorts were seen again, and I was surprised and pleased to discern five examples of the large, black antarctic petrel known as *Procellaria æquinoctialis*, which evidently migrates all the way to the northern end of the Humboldt Current.

As we approached the Eten roadstead, I had the



FLEDGLING GUANAYES AT SWIMMING PRACTICE IN THE ROCK POOLS OF LOBOS DE TIERRA.

In the background are basking sea lions.

dubious entertainment of watching the last steamer on which I had a chance of securing passage for at least eight days weigh and start southward toward distant Callao. We came to anchor off the Eten pier at half-past two in the afternoon, our flag flying to indicate that we wished to be received. The captain of the port kept us waiting two hours in a terrific swell before he sent a subordinate to examine and accept the despatch papers issued by the lighthouse keeper of Lobos de Tierra. Otto fumed at the unwarranted delay, swore the most Gregorian of Spanish oaths, and attempted to keep up his spirits by singing sea ditties learned in the British merchant marine, but the Indians accepted the matter with absolutely no show of restlessness or discontent. Just as we finally made a precarious landing at an iron stairway leading to the pier, the round face of Señora Nicholas appeared suddenly in the light of day, and we realized that we had had the good soul all the way.

After various preliminaries, and amid expressions of astonishment that a foreign *caballero* had come from the Isla Baja in an Indian fishing boat, my baggage was swung up onto the dock. This is always likely to be a wracking process to the owner, if he happens to be a witness, and the present instance was no exception. The things were bundled into a single strap-loop in a most casual way, and then hoisted on the crane out of the bouncing boat. It nearly made my heart stop

beating when a load of trunks and boxes, cans of specimens in formalin (mostly upside down), duffle bags, camera cases, and what not, swung far out over the dizzy water, threatening every moment to fall apart. If casualties do occur at such a time, a plain statement on the back of your receipt assures you that the agents can not be held responsible for "acts of God."

Luggage and owner at last safe, we shot along at high speed on a flat car, down the pier and through the cut in the cliffs to Eten. I secured quarters in a miserable hotel, ate an abominable dinner, and crawled into an uncomfortable bed in a stuffy room. As I looked out in the evening, the drab port, with its low, monotonous adobe buildings, dirt streets, and no green leaf, seemed the saddest spot on earth.

It has been previously recorded that along the northern coast of Peru the zone of cultivation lies at some distance from the sea, with extensive desert areas between the *haciendas* and the shore. This type of country is altogether characteristic of the Department of Lambayeque. At Eten Head the great rollers of the Pacific break against cliffs of hard, fine-grained silt, from the brink of which arid wastes stretch inland until they gradually give way to sparse pastures and, ultimately, to emerald fields of rice and cane in the fertile bottom land of the River Lambayeque.

After one night in Eten, I took the railway to

Chiclayo, the metropolis of the valley and province. The country along this fifteen-mile line is well-populated, the majority of the inhabitants being, of course, the native Indians. Most of the women wear low-necked cotton garments, revealing handsome chests and shoulders. The making of hats seems to be an almost universal industry. One sees persons of both sexes and all ages weaving the straw as they go about their daily life, indoors and out, their fingers plying nimbly while they stand at their thresholds to watch passing trains or trudge along the paths to the fields.

Chiclayo, where I spent a thoroughly enjoyable week, is an attractive and apparently clean town despite a lack of adequate sanitation which has been reflected from time to time in epidemics of yellow fever. Its cathedral, unused, unfinished, and sealed up with adobe bricks to await more prosperous years, faces a green and flowery plaza. The adjacent Royal Hotel offers its guests the best that the region affords in the way of lodging and the fruits of the soil. The surrounding countryside proved, however, more interesting to me than the city itself, and, through the hospitality of the proprietors of the Pomalca sugar plantation, I was supplied with saddle horses for delightful rides in all directions, including trips to the venerable town of Lambayeque and to the beaches at Pimentel and San José.

I was told by Señor Gerardo Klinge, who

operates Pomalca, that the valley of Lambayeque is unique among Peruvian agricultural districts in that no less than five thousand proprietors share in its ownership. The neighboring valley of Chicama, on the other hand, is practically controlled by the overlords of four estates.

The mill at Pomalca, which is equipped with New Orleans machinery, was operating eighteen hours a day, under a two-shift system. At the date of my visit, the wheels had not been stopped since April, 1917. Owing to the prevailing dearth of shipping, a great accumulation of crude sugar was on hand, but it had all been sold to Chilean agents and fully insured by the purchasers.

Pomalca employs from eight hundred to a thousand workmen, who live on the *hacienda* in most fortunate circumstances because the owners have long been leaders in progressive efforts toward the betterment of labor conditions in Peru. In the first place, the employees are well housed. One-story brick apartments, arranged in quadrangles and of the same architecture as the sugar mill and the manager's home, have been erected in sufficient number to accommodate the families of the entire force. Running water is supplied, and window screens are installed for all who desire them. Strange though it may appear, some of the natives, with a persistence equally hard to comprehend or to overrule, prefer mosquitos to screens. Any man who wishes to start a savings account under the

jurisdiction of the firm is advanced a sum of fifty soles. He may refund this from his earnings at the rate of one sol (about fifty cents) a week, and all the while receive interest upon the full amount of his deposit. Most of the workmen are surprised to discover how relatively easy it becomes for them to save. The estate, furthermore, lends money on liberal terms to heads of families who wish to buy land. Workmen who show a tendency to drink are closely watched, and habitual drunkenness has been practically abolished.

So much has been published about peonage and other industrial abuses in Peru that it is a pleasure to record instances of modern and enlightened systems which came under my observation. The operations of the guano administration, for example, are conducted with reasonable regard for the welfare of the laborers. The men who are transported on contract to the guano islands are, for the most part, mountain Indians. Their daily wage is 1.20 soles and food, the latter consisting of .16 ounces of rice, 12 of beans, 8 of meat and 3 of sugar. With the morning and evening meals they also have tea, and at noon a bowl of soup or stew. On Sunday each man receives three and one-half pounds of hard bread as a week's ration. They have the privilege of buying additional bread, as well as canned products and tobacco, at cost. Alcoholic drinks are absolutely prohibited. No bedding and no shelter other than burlap sacks,

are provided, but it should be borne in mind that the region is rainless. The men bring their own woolen ponchos and blankets, and use the sacking to construct the huts in which they sleep. They begin the day at seven o'clock in the morning, and labor eight hours, exclusive of a two-hour siesta between eleven and one. On Sunday they are, of course, free to spend their time as they please, and on national holidays the managers of the various islands usually arrange programs of games and sports in which all participate. The only serious lack that came to my attention was the insufficiency of sanitary accommodations, which led to the propagation of swarms of house-flies, and in other ways menaced the generally healthful conditions on the islands.

Vivid recollections arise of my journeys round about Chiclayo—in the pleasant company of new friends and mounted upon excellent horses from Pomalca which, like their ancestors from Spain, have an easy, pacing gait and go through life unshod. Particularly memorable is an afternoon ride to the town of Lambayeque, a place which surely seems part of the old Peru, untouched by the march of modern events. It lies in the verdant valley of the river, with tall palms and thickets of acacia round its margins, and dense, dark-green, shade trees in its central square. To enter you ride between rows of low-walled adobe houses, through lanes piled high with dusty sand where foot-loose

horses, burros, dogs, goats, fowls, and tattered children move reluctantly aside to let you pass. Then suddenly you come into the speckled sunlight and shadow of the square, with its pavement of small, uniform cobbles, a noble church half-hidden in glossy foliage, and the charm of ancient, balconied dwellings. Along the main street of the town the balconies continue, together with beautifully carved doorways and window frames, the best examples of the bygone architecture that I saw in Peru albeit much of it is falling into ruins. Indians wearing broad-brimmed hats and rich blankets pass along the narrow sidewalks against an appropriate background of tinted walls. Outside many doors, sleek and sturdy horses of Arab type, with the black-fringed national saddles upon their backs, stand untethered, awaiting the return of their riders.

We came to Lambayeque for the special purpose of visiting a German archæologist, Señor H. Enrique Brüning, who has lived for half a century in Peru and who owns one of the most important collections of Indian relics in the Republic. We found the elderly scholar at his desk in a roomy study. His library of scientific works dealing with his adopted country was a pleasure to inspect, and I learned that he was no less well acquainted with the geology, botany, and animal life of northern Peru than with the history of its ancient people.

Señor Brüning's assemblage of pottery and other ethnographic material is very remarkable, and is

housed in a separate museum building which connects with his library. With scientific thoroughness he has limited his collecting to the adjacent region, and each piece is accompanied by precise data. Besides hundreds of earthen vessels, the treasure includes exquisite copper objects such as masks, ear-plugs, breast-plates, and ceremonial utensils, as well as rare copper castings. Still more notable are numbers of the ancient moulds and the original solid models from which the aborigines reproduced their vases and jars.

Our return from Lambayeque to Chiclayo was in the coolness of late afternoon, against a light breeze. With its veritable jungles of shrubs and small trees, flooded rice fields of the most brilliant green, and a profusion of birds, the country seemed far more charming than a stranger who saw but the barren seashore could surmise. Tiny lizards sprang out of the ruts in the road under our horse's hoofs; blue-green parrots no bigger than sparrows clung like bobolinks to the tops of tall reeds; and a bottle-blue king-fisher—the *Martin Pescador* ("Martin the Fisherman")—plunged for minnows in the puddles of irrigation water. Coots were feeding in the sloughs and jack-snipe around their borders. In the lush vegetation of the wettest places the air rang with full-throated songs of mockingbirds and grackles, the latter far more musical than ours at home. Vermilion flycatchers and yellow *arrozeros* (rice-finches) made up in

color what they lacked in melody. Burrowing owls, just emerging from subterranean homes as the sun sank low, blinked at us from sandy hill-sides, and diminutive elf-owls, the smallest members of their tribe, sometimes allowed us to ride within arm's reach as they sat jerking their tails on the low branches of acacias.

Along the road we met caravans of burros laden mostly with fire-wood or sacks of grain, though we saw at least one of these humble beasts with three stalwart boys astride it. Other boys were driving herds of goats and of thick-horned bullocks which lowered their heads threateningly toward our mounts. Indian mothers on horses or mules were nursing their babies while they jogged along, an operation I had never before seen under such extraordinary circumstances. In the willow-lined canals women and girls were washing clothes, or, their day's work finished, were squatting up to their chins in the cool water. My Peruvian companions had a joking greeting for each of them, especially for the pretty ones, and all made merry, flirtatious replies. There is something richer in a Spanish salutation than in that of any other tongue, partly because of the sound and significance of the word "señor," which is never omitted. Our English "sir" is apt to be forced or stilted, and "mister" is nothing short of hideous, but the high-sounding "señor" is inherent in the genius of Castilian speech. Regardless of his rank or station, every

man is "señor" in polite discourse; likewise the fish-woman in the market place is addressed as "señora," the same term that would be applied to the first lady of the land.

Before we reached Chiclayo, we spurred our horses to the summit of a bare hill and watched the sun go down. A mellow, amber glow lay on the broad green plain and on richly shadowed mountains far to southward. Over the distant Pacific a rosehued curtain was forming above the sinking sun. As we turned to resume our way, we could see the yellow walls of Chiclayo, and the square towers of the cathedral looming above a copse of thorn-trees. In the foreground a poncho-clad horseman was climbing the slope toward the city. From all appearances we might have been out of the New World—on an arid plateau of Castile, perhaps at the very gates of old Toledo.

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